MAR 25 1944

HEATING AND VENTILATING

MERCIAL, INDUSTRIAL AND INSTITUTIONAL AIR CONDITIONING, REFRIGERATION, PIPING, HEATING, VENTILATION

Blackout at sea has created severe ship ventilation problems. See article by John W. Markert, U.S. Maritime Commission.

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A MONTHLY
MAGAZINE FOR ENGINEERS
AND CONTRACTORS CONCERNED WITH
COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL AIR CONDITIONING, REFRIGERATION, PIPING, HEATING, VENTILATION

HEATING AND VENTILATING

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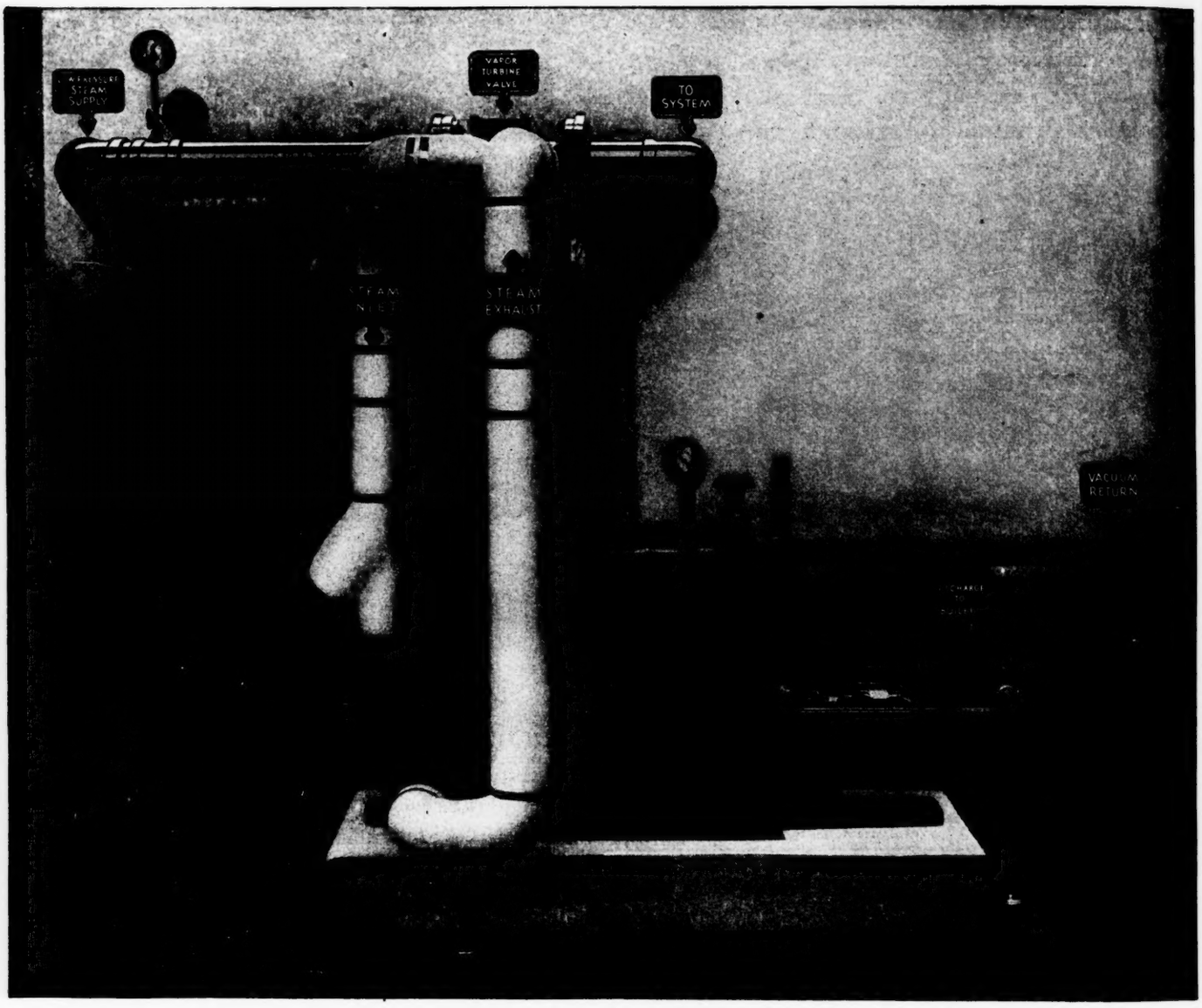

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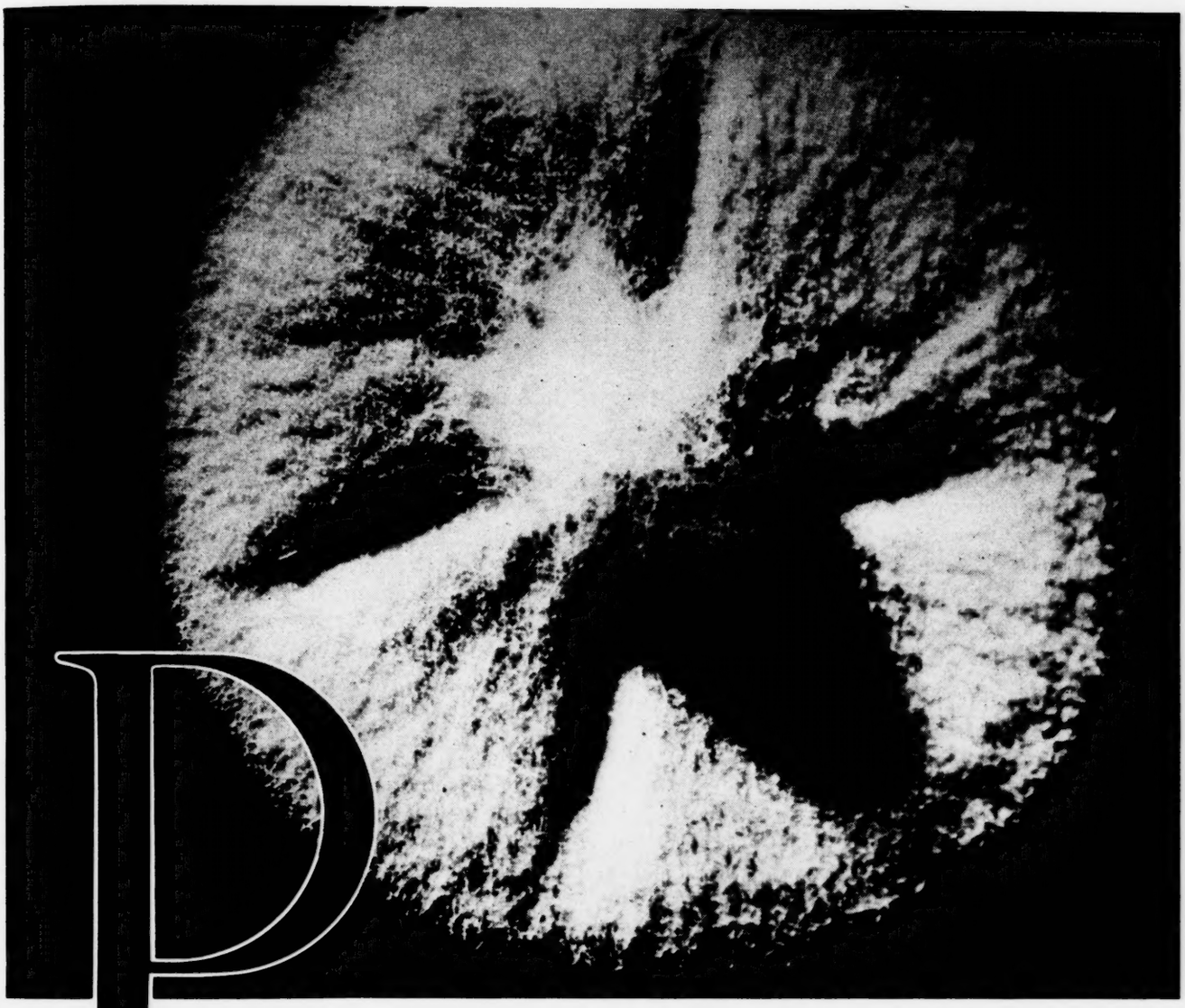


Penicillin

Mass production of this miracle drug is only possible because of the industrial cooling and air conditioning employed

LESTER T. AVERY
President, Avery Engineering Company, Cleveland.

"SAVE the temperature and you save all." This slogan, borrowed from the paint industry, twisted a bit, tells the story of the birth, growth and end of Penicillin, the "Miracle Drug." One degree change in temperature—the wrong way—at the wrong time—will reduce the yield or even spoil the crop. Dirty air or air-borne bacteria are also a hazard. Humidity must be controlled within reasonable limits. So here is true air conditioning applied to preservation of human life, and yet the physician or patient thinks little, if at all, of the skill in temperature control that produced his bottle of orange powder. It might be ground up soy beans for all he knows!

Shall we start at the beginning? That's the trouble with engineers, they always want to start at the be-

ginning and develop the complete story in logical sequence. In this case, however, we are going to start at the end and jump around. Maybe then we will have the picture complete and can arrange the parts in order without too much trouble. Fleming, the English biochemist, started it all when he reported in 1928 that he had trouble with bacteria growth on his slides in the vicinity of mold growth which developed on the culture media. He identified the mold as containing Penicillium Notatum—then forgot it! And thousands of doctors, particularly the medical students, used Penicillium Notatum to control and limit bacteria growth on slides used in medical school and each and every one of them overlooked the *significance* of what they were doing!

A couple of years ago some new interest was aroused and the U. S. Department of Agriculture at Peoria began to raise small quantities of Penicillium Notatum and from it prepared Penicillin. The English people place the accent on the second syllable—Pen*i*cillin, but the men we work with say it this way—Peni*cill*in. Right now Albert Elder, an industrial chemist, is the WPB coordinator of the Penicillin program and under his direction 22 new plants are being built all over the country. The capacity of each plant is a military secret, the total capacity even more so, and right now there is only a limited quantity for experimental use.

I've seen it claimed in public print that by June there may be Penicillin for civilian use as well as for the armed forces. If you want to know how big and important this crop is, you can say it is going to equal and surpass the line of Sulfa drugs. Penicillin does things Sulfa can't do and does them more easily. They need all they can get now for treating gonorrhea, and staphylococcus infections of all kinds, so that they haven't wanted to claim much in other fields of medicine. One type of pneumonia is supposed to respond to its use. When supplies are more easily obtained, new uses will undoubtedly be found—and announced. So much for the *why* of Penicillium Notatum.

But you can't scrape the mold off bread or cheese and cure gonorrhea! There are two kinds of mold—Aspergillus, which is the kind found on bread, for example, and is of no interest or value, and Penicillium, the mold on some cheese, for example Roquefort. This is not a new word. My encyclopedic dictionary, printed in 1897, says "Penicillium . . . the well known blue molds . . ." But if you want Penicillium Notatum in any purity and quantity that is practically useful you raise it and you start with a mold grower, more properly called a culture medium.

You really start with the spores you get from the U. S. Agricultural Experiment Station at Peoria. Dr. D. Roy McCullagh, vice-president of Ben Venue Laboratories says he brought his spores back from Peoria in a vial in his vest pocket. These spores have been developed and now Ben Venue is producing Penicillin in quantities in a pilot plant, and has ample spores to start the growth in the fine new plant at Bedford, Ohio. They produce Penicillin under the flask method. Some growers use the tank method and some the flask method, so that if some of the steps we mention are peculiar to Ben Venue just accept it as something they do to improve quality, quantity or reduce cost. Certain strains of Penicillin-producing spores work better with one system than another. For example, a new strain has been developed, scraped from cheese, that was in the home of one of the Peoria residents, possibly someone working in the Laboratory. Another strain has been taken from mold growing on cantaloups found in one of the Peoria markets this summer.

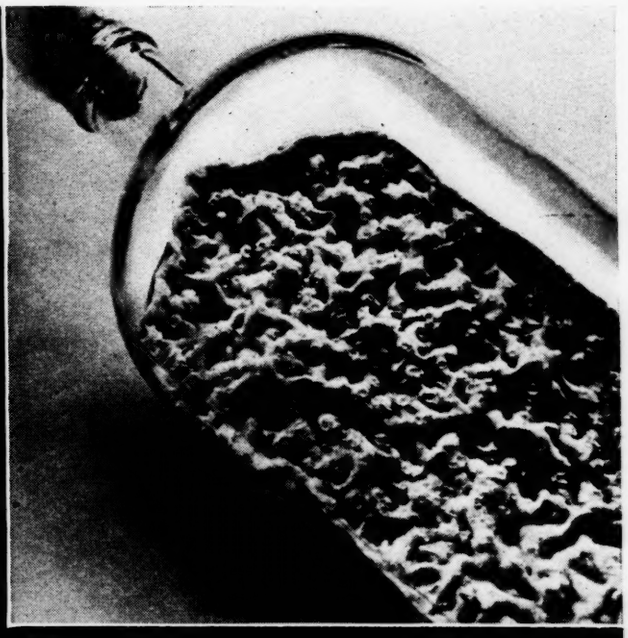
Getting back to the spores, you inoculate them into culture media which are in a special one quart flask. This is done in the Sterile Inoculation Room held at 75F. The air is cleaned by a Precipitron air cleaner and the air unit handles 1000 cfm with chilled water cooling coil and electric strip heaters. The mold grower is a mixture of corn steep liquor with traces of copper and magnesium salts, iron, zinc nitrates, milk sugar and other witches' brew. You don't want to grow this stuff yourself but if you did you have to feed it carbohydrates for energy and protein for growth so this mold grower is being studied and improvements may be expected. The above mixture is the January, 1944, vintage.

But hold fast! These bottles have to be sterile so they are put through autoclaves—large size sterilizers to you—and the outlet from the autoclave is the first room for our air conditioning. Here we hold any temperature resulting from a capillary air washer delivering 3000 cfm saturated and cleaned with a Precipitron. The exhaust fan with hoods over the autoclave door takes out 3150 cfm. The glass bottles come out of the sterilizer at 250F on steel racks and the plan is to hold the room down to 95F to 100F. The racks of flasks are then wheeled into the sterile Inoculation Room where they are cooled to about 85F. The room is held at 75F and is supplied with clean air from a Precipitron. Then the spores are innoculated into the flasks.

So now we have sterile bottles containing culture media inoculated with Penicillin spores. These are assembled on racks, lying flat with offset necks stuffed with sterile cotton and these racks are wheeled into the incubation rooms. Here let us check the flow diagrams, pages 50 and 51, to tie these steps together.

It's in the incubation room where you really get down to cases on the temperature control! This room is 30 ft long, 15 ft wide, 8½ ft high and is filled with racks holding trays of flasks. Incubation starts at 82F and is continued 6 days ending at 68F. The relative humidity is held up to 50% at the start and allowed to increase as the temperature drops. The temperature gradient across the room horizontally, longitudinally and vertically must be held within ½F. This is necessary in order to control the growth of Penicillin accurately and to have the entire room full of flasks at a uniform stage of growth and therefore maximum concentration of

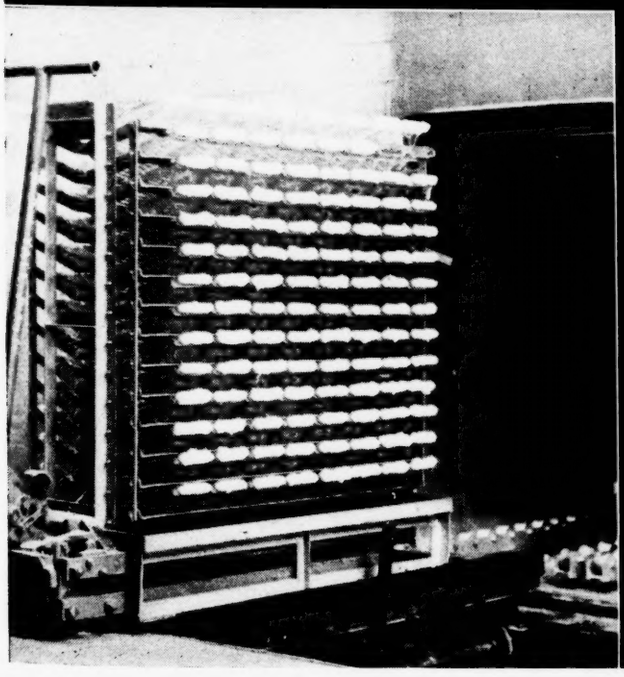
(Below). One of the first steps in the manufacture of penicillin is the sterilization of the flasks. This view shows a truckload of flasks being removed from the autoclave sterilizer where they have been subjected to a temperature of 250F and from which they are wheeled into the air conditioned inoculating room which is supplied with clean air from a Precipitron in series with a capillary air washer. This room is held at a temperature between 95 and 100F.

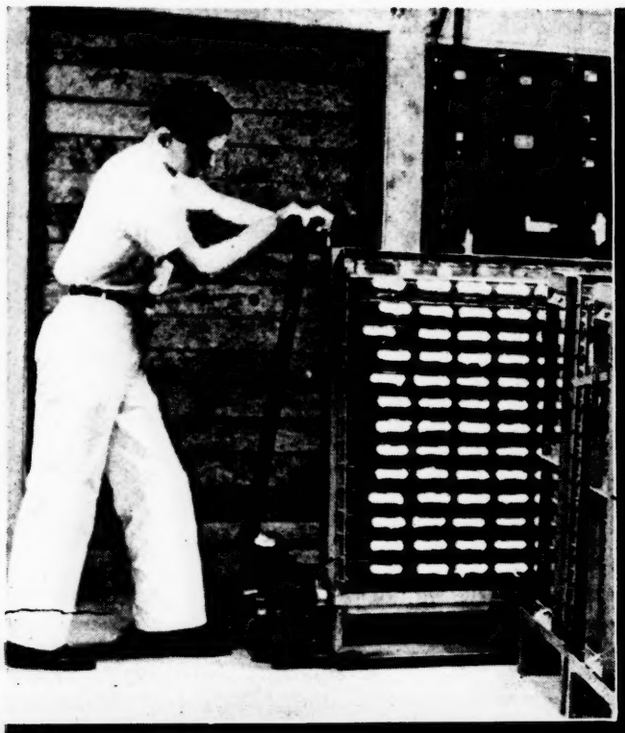


(Lower Right). Next important step in the process is inoculating the penicillin-producing spores into the culture media. In the view shown this is being done in gallon jars, but at the Ben Venue plant the inoculating is done in special quart flasks. The operation is performed in a sterile inoculating room where the temperature is held at 75F. Air for this room is also cleaned by a Precipitron, then passed over a chilled water coil, a strip heater, and thence to a fan.

(Center Right). The flasks containing the culture media as they appear in the sterile inoculating room at the Ben Venue plant. The mold grower is a mixture of corn steep liquor, with traces of copper and magnesium salts, iron, zinc nitrates, milk sugars, and other ingredients. The penicillin mold grows on this diet.

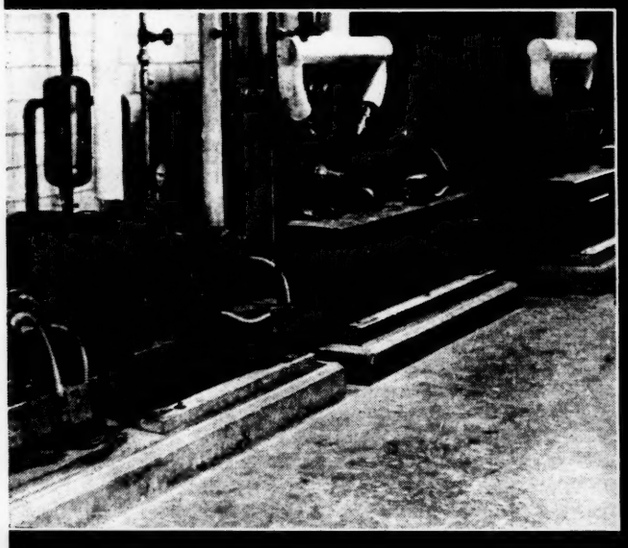
(Upper Right). A close-up showing how the penicillin spores develop into a healthy mold when they are inoculated with the proper type of mold grower. A magnified view of the penicillin mold is shown on the first page of this article.





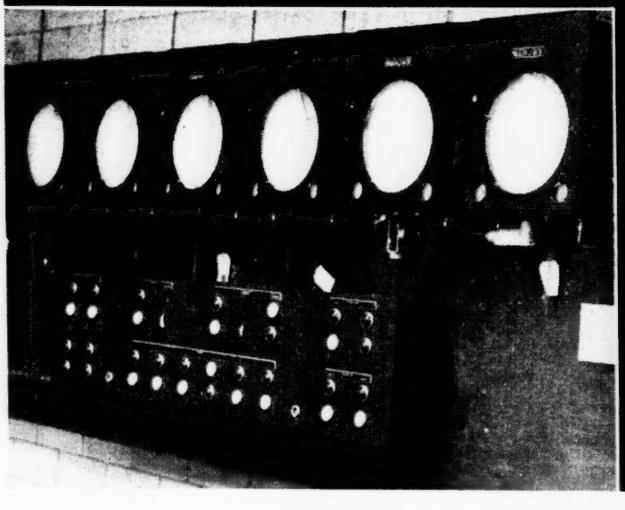
(Left). These truckloads of flasks are being wheeled into the incubation room where the process starts at 82F and is continued for six days, ending at 68F, and where the relative humidity is 50% at the start and increased as the temperature drops. The temperature gradient across the room in all directions must be held within 0.5F.

(Left Center). The Worthington methyl-chloride condensing units used to provide refrigeration for the various processes in connection with the manufacturing of penicillin at the Ben Venue plant.



(Lower Left). Control of the temperature in the incubation rooms is accomplished by these Brown Instrument recorder controllers located in a central control room from which the six rooms can be watched and conditions changed as desired.

(Below). A finished ampule of penicillin ready for packing. Before the penicillin reaches this stage, however, it has passed through chilled tanks, freezers, and dryers, and finally stored at 40F. Refer to the flow charts on pages 50 and 51 for the complete cycle.



Penicillin at the end of the 6th day when the yield is taken.

You can imagine the waste if part of the flasks were appreciably slower in growth than others as a variation of temperature of 1F the wrong way may change the yield many fold. Hold the temperature uniform and yet permit the change of 14F in 6 days in any desired steps. Here the biochemist and the mycologist step in to improve the process, product and yield and say many improvements can be expected.

At Ben Venue there are six incubating rooms, one for each day, so that one room is emptied and recharged each day. This means that there are six different temperatures in the six rooms on any one day as each crop is in a different stage of growth. The conditioning unit for each room is horizontally suspended, specially built, with chilled water cooling coil, electric strip heaters, humidifier, filter, fan for 4000 cfm capacity. The control is accomplished by a controller recorder located in the central control room where the 6 rooms can be watched and conditions changed as desired. The controller works progressively on the steps of heater control and chilled water valves and humidifier.

So the crop is ripe, the yield is good and it's time to take it away. Temperature control is still of the essence! Penicillin is not the mold but *on* the mold and in the residual solution in the flask, so this is poured off into the tank of a Baudelot cooler and chilled rapidly to 35F. Ethylene Glycol brine is used for this chilling. The mold is strained off and burned.

The process of reducing these media and increasing the concentration of Penicillin is the next interesting step. Amyl Acetate is added and the pH adjusted and temperature raised to 75F so that the Penicillin moves over into the organic solvent. This mixture is centrifuged, the media discarded to sewer and the Amyl Acetate with Penicillin recovered and chilled to 35F. Water is then added, temperature raised to 75F and pH readjusted with Sodium Carbonate so that Penicillin moves over into the aqueous solution. This mixture is separated and once more an organic solvent added, the pH changed, the Penicillin moves over to the solvent and the water centrifuged away. This step is reversed once more and you end with a solution of concentrated Penicillin in water *250* times its original concentration. This is chilled to 35F and placed in 24 cc bottles, 16 cc of liquid in each. The trick is to end with a concentration of better than 100,000 units of Penicillin in this 16 cc. Assay is being run concurrently with all steps in the above which takes place in the Purification Laboratory. If and when the concentration reaches the desired minimum of at least 100,000 units in 16 cc the bottles are filled and placed in a shell freezer and spun to freeze at —50F.

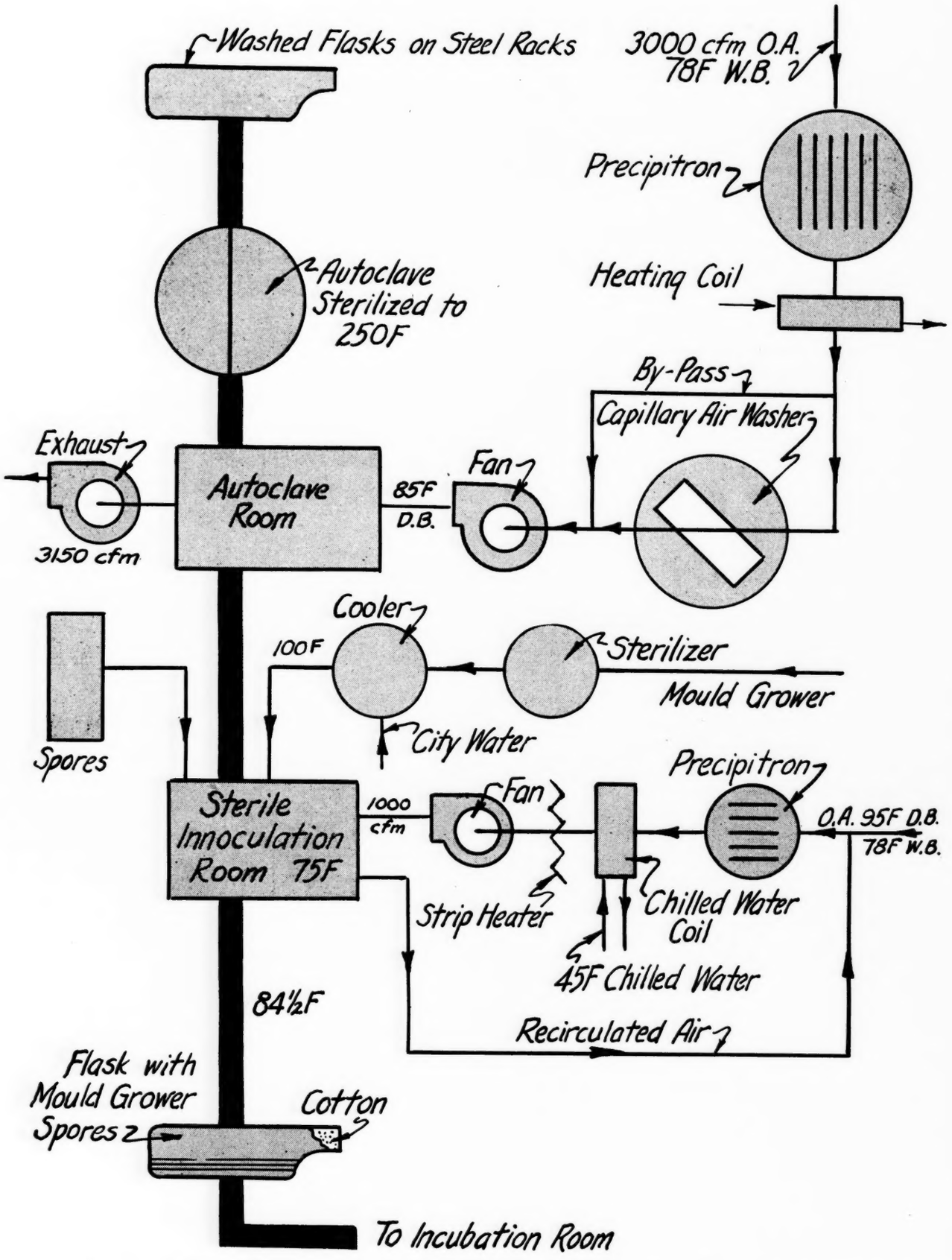
When frozen solid, or shall we say in a hollow cone, the bottles are collected and stored at —10F in a freezer until enough are available to charge into the dehydrator. This is accomplished in a tank with a low vacuum 75 microns absolute pressure cooled to —30F then heated to 75F. The vacuum pump discharges into a refrigerated tank at —70F to keep the vapor pressure at a minimum. The Penicillin is a dry powder, 2% water permitted but with this process there is less than ½% moisture. The room in which the dried Penicillin is withdrawn from the vacuum chamber is maintained at a very low humidity to prevent moisture regain. The bottles are stoppered at this point and from then on are handled as a dry powder. They are stored in a conventional refrigerator at 40F until shipment and have a useful life of 3 months at ordinary temperatures. As engineers, our interest in the product ceases when it comes out of the storage refrigerator and is shipped in cartons to hospitals and medical centers. Maybe sometimes we, as *patients* yanked back from the jaws of death, may be much *more* interested in this little bottle of powder!

Now that we have shipped the Penicillin, we return to the temperature system. The Penicillin chilling system includes the first Baudelot cooler step and then the Penicillin tanks, where alternately the Penicillin is moved from water to organic acid and back. For this we use Ethylene Glycol brine at 25F. The brine is cooled in an open tank by duplex refrigerating machines and circulated by duplicate pumps. Temperature control is by automatic valves at the several coolers.

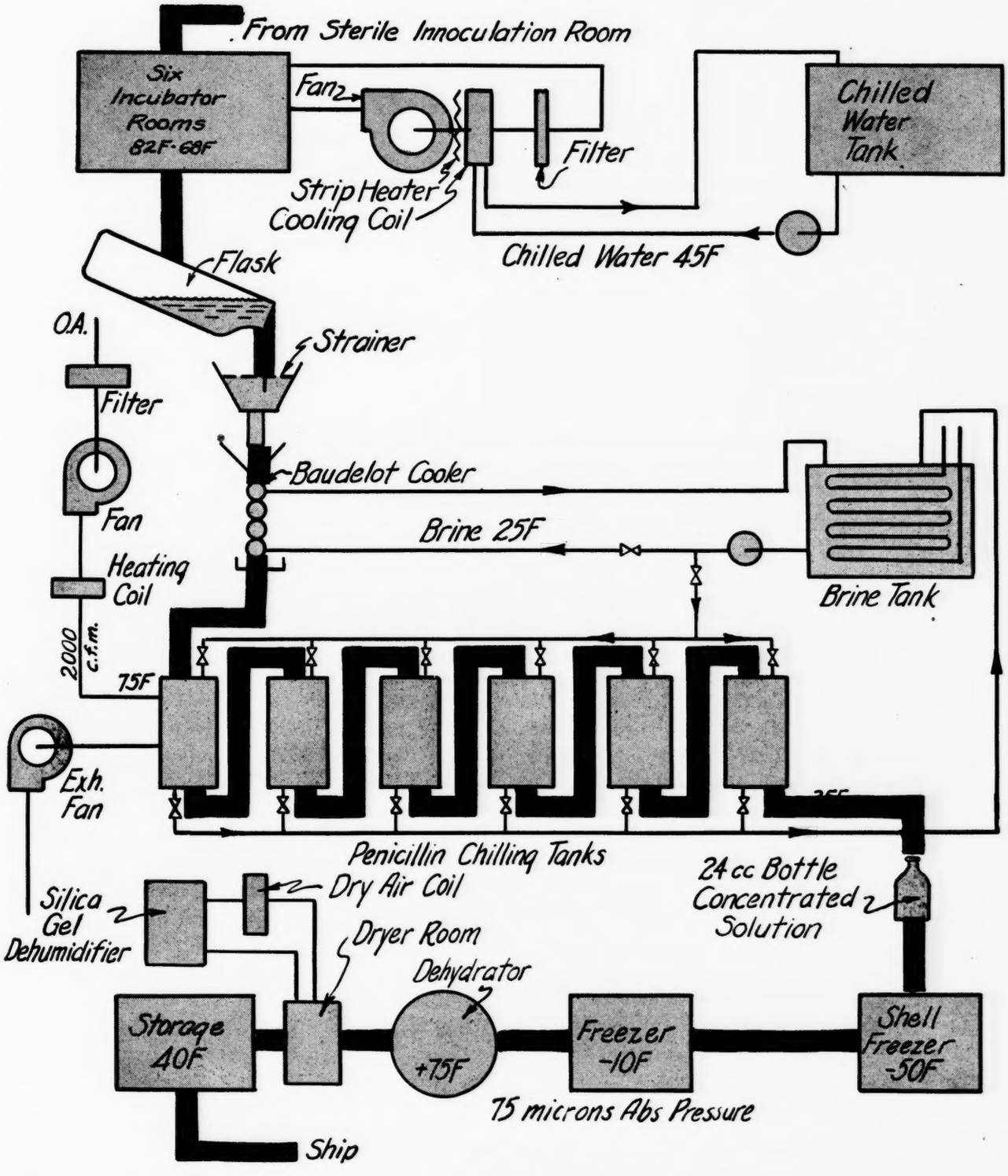
The Purification Laboratory is held at 75F and the ventilation includes a 2000 cfm supply fan with heating coil, filter and control. The exhaust fan is 2250 cfm and provided with explosion proof motor, due to hazard from ether fumes.

The Penicillin Storage Room is cooled with direct expansion plates connected to a separate compressor. The freezer storage is equipped with shelf plate coils and separate compressor.

Professor Alexander Fleming, the English biochemist, who identified a mold which settled and killed bacteria in his laboratory as Penicillium Notatum, and thus made the first step which finally led to the development of Penicillin.



First portion of the process of penicillin manufacture is shown above. For continuation see next page.



Continuation of process. Note the multiplicity of air cleaning, refrigeration, heating, dehumidifying and air handling equipments employed in the process.

There are a few other applications of temperature control, chiefly for experimental and development work, but of no great significance as part of this production picture. The flow diagram, above, completes the story.

Probably production of Penicillin had to wait for the "know how" to control temperatures so vital to its growth. You can take increased pride in your profession which has found one more way to apply its skill to saving human life.

The New Significance of Refrigeration

REFRIGERATION has passed another milestone of development. Traditionally associated with food preservation — almost its sole market till the nineteen twenties — the first important broadening of its range of applications came when this art was combined with that of heating and ventilating to produce Air Conditioning which, during World War II, has attained a major status in the installation of thousands-of-tons of capacity in vital war plants.

But even before the second World War, utilization of refrigeration for still other purposes had begun — that of directly chilling, freezing or storing with refrigeration batches of materials or goods to further a manufacturing process or to preserve some characteristic of the material. This type of refrigeration, differentiated in nomenclature from refrigeration for food preservation and air conditioning by the phrase Industrial Refrigeration, made almost imperceptible headway prior to a few years ago. But the demands brought about by the war to meet heretofore undreamed-of processes, to save time, to reduce rejects, so accelerated the growth of Industrial Refrigeration that, as was Air Conditioning, it is now recognized as a significant production tool.

The heating, the air conditioning, and the refrigeration engineer all deal with heat engineering or, in classic phraseology, thermodynamics. As a matter of fact, many readers of HEATING AND VENTILATING commonly deal with all three phases of the broad field. For this reason HEATING AND VENTILATING, aware of the quiet but rapid development of Industrial Refrigeration, has for some time been keeping in close touch with its advance, and publishing in each issue articles dealing with the problems of specific applications.

Some idea of the potentialities in Industrial Refrigeration may be gained by the following list of typical present-day applications: Cooling of welding tips, making shrink-fits, annealing of certain metals, testing of an almost limitless variety, electroplating, photographic processing, metal aging, processing of penicillin (see preceding article), blood plasma, and the manufacture of various explosives, synthetics, chemicals, and petroleum products. In a few years this list may, perhaps, not even be representative.

In publicizing the technical advances of Industrial Refrigeration, HEATING AND VENTILATING has as its objective keeping its consulting engineer, industrial engineer, contracting engineer and other engineer readers fully acquainted with succeeding advances in both theory and practice in this relatively new field.

Clifford Strock
EDITOR

Evaporative Cooling

has notable advantages in air conditioning applications, including conservation of critical materials

T. W. REYNOLDS

AT the present time, both refrigeration equipment and Freon are difficult to obtain for general use.

Evaporative cooling, therefore, assumes added importance and significance. It is simple, economical and, what is more important, it is available. When the war is over refrigeration can easily be added if desired.

If ventilation alone were employed, an infinite quantity of outdoor air would be required to approach outdoor summer conditions in a plant having considerable heat load. On the other hand, with evaporative cooling, air may be introduced at the outdoor wet bulb, which is usually 10 to 20F lower than the outdoor dry bulb, and then when a sufficient quantity of this air is cooled to the wet bulb, conditions indoors can be maintained at a considerably lower temperature than outdoors. This would be irrespective of the heat load produced in the conditioned space.

With evaporative cooling it is always possible to obtain conditions which fall within the safety zone of effective temperatures. This zone may not always be comfortable, but it will be safe. With straight ventilation, it is impossible to obtain safe conditions irrespective of the quantity of air moved. Consequently, industry has a definite "out" as far as labor is concerned if evaporative cooling with capillaries is installed.

The capillary type of conditioner is definitely to be construed as a filter and consequently can be substituted for filters where they are required. In other words, they may be called "wetted filters." If it is desired to maintain an equilibrium between saturation and existing entering conditions, this can be accomplished in the capillary conditioner by a retarder, such as calcium chloride, lithium chloride, or triethylene glycol, or by intermittently wetting the cells without detracting from or losing the cleaning quantities of the capillaries.

The capillary air conditioner is a form of air washer, air filter, humidifier and evaporative cooler. Dehumidification and further cooling may be accomplished by the use of cold water from wells, an ice melting bunker, or by the use of mechanically chilled water. Use of this filter will reduce ventilation quantities where humidification only is required (as in textile mills) compared to other forms of washers with lower saturation efficiency. In many cases, it avoids the use of refrigeration equipment. This condition decreases the critical materials and power required for pumps due to lower water and pumping head requirements. Often eliminates the use of cooling coils where well water is used, and when designed for 96 to 97% saturation efficiency, creates less static than other washers designed for the same function. When supplemented with refrigeration equipment which calls for cooling and dehumidifying a part of the season, it cuts power consumption and seasonal costs, for no refrigeration is required whenever the outdoor wet bulb temperature is at or below the required dew point. In many cases this equipment insures continuity of production should refrigeration equipment break down.

The capillary air washer divides both the water and the air into fine streams flowing together

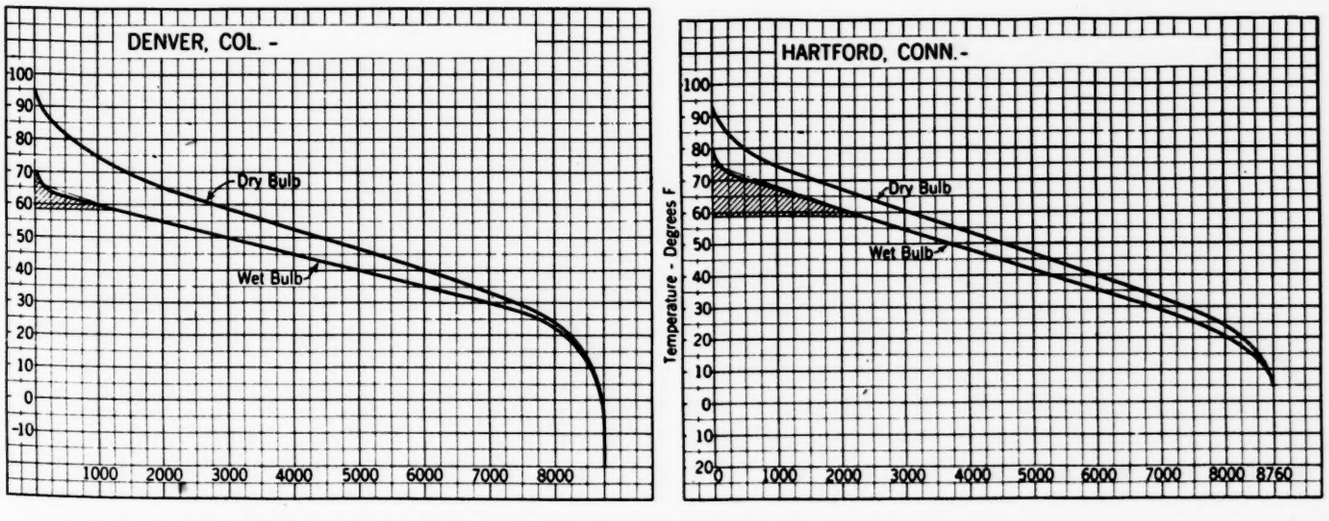


Fig. 1. Temperature analysis charts. Illustration courtesy Air & Refrigeration Corporation, New York.

through low resistance channels. The good contact between air and water gives a high saturation efficiency with correspondingly lowered air quantities, smaller apparatus and ducts, and decreased initial and operation costs.

For example, with 70% relative humidity, as in a spinning room, with 95 DB 75 WB outdoor design, a saturation efficiency of 97% with a capillary air washer would give a leaving dry bulb temperature of 75.6. As compared to a washer with a saturation efficiency of 90%, the leaving dry bulb temperature would be 77F. In order to maintain 70% relative humidity, the air quantity required must be sufficient to limit the temperature rise in the conditioned space to 85.7F in the first case, and 85.2F in the second case. By computation, the corresponding air quantities to be absorbed in the space are found to be 5550 cfm and 6830 cfm. Thus, a decrease in saturation efficiency for the given case resulted in a 23% increase in the required air quantity.

Spray washers which atomize the water in the moving mass of air have efficiencies from a low of 60% with one bank of sprays downstream to a high of 95% with one bank of sprays downstream and a second bank upstream. These efficiencies require per 1000 cfm air handled, from 5.5 gpm to 15 gpm water for the most efficient arrangement; with nozzle pressures from 15 to 20 lb; overall recirculating pumping heads from 45 to 70 ft. The capillary cell has 97% saturation efficiency with only 0.6 gpm per 1,000 cfm, 6 lb nozzle pressure, and with a pumping head for all units of 22½ ft plus the height in feet between the tank and the top spray header. Actually, the water requirements are set at a minimum of 3 gpm to insure effective and continuous flushing of the cells.

Whenever the outdoor wet bulb temperature is 60F or below, effective cooling and comfort can be maintained in the conditioned space by evaporative cooling without refrigeration. Air conditioning units, using only refrigerating or cold water coils, will in most cases call for refrigeration whenever the outdoor dry bulb temperature exceeds 60F. A capillary conditioner could deliver air at 60F or less for all but 800 hours in a season at Denver, and all but 2,200 hours in a season at Hartford; a coil system without evaporative cooling would require refrigeration to deliver 60F air for 2,750 hours per season in Denver and 3,000 hours per season in Hartford.

Air conditioning for comfort usually calls for 80 DB, 50% RH which in turn requires a dew-point of 59.7F in the conditioned space and for the usual internal latent heat load at 58 DP for the air supplied to this space. Therefore, a capillary air washer would be sufficient without refrigeration whenever the outdoor wet bulb is 58F or below. Referring to the shaded areas of Fig. 1, between the 58F line and the wet bulb line as shown by curves on the accompanying temperature analysis charts, refrigeration would be required in Denver for 1,250 hours and in Hartford for 2,350 hours. These curves, incidentally, were plotted from U. S. Weather Bureau observations and show also the wide difference in wet bulb conditions in mountain and coastal regions.

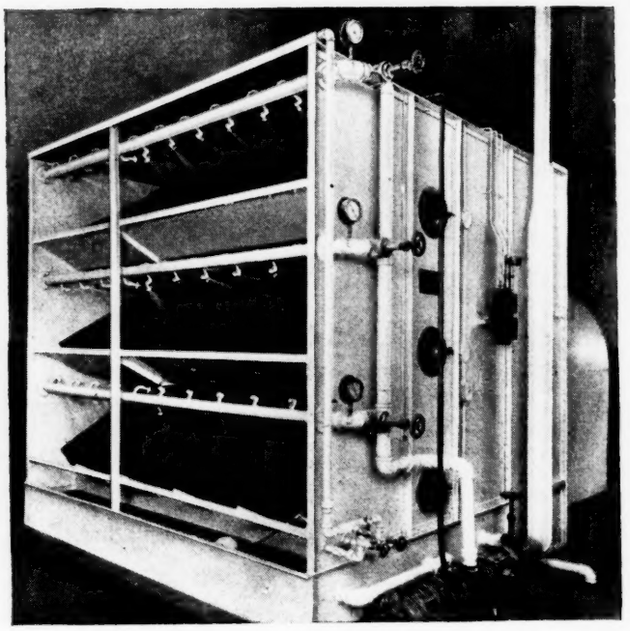


Fig. 2. A standard size capillary central station installation with nominal capacity of 30,000 cfm. Photo courtesy Air & Refrigeration Corporation, New York.

Possible savings that can be made with capillary air conditioners should be investigated in those systems which require humidification as well as cleansing of large quantities of outdoor air. Excessive air quantities are particularly required for make-up air to spray booths and this air must be clean. Furthermore, substances which are a nuisance when discharged outdoors, and substances which normally condense on coils, are absorbed, condensed and carried away in these washers. This reduces the nuisance value and the amount of exhaust and corresponding make-up air otherwise required for the removal of odors from condensation on coils.

Generators and large motors in confined or hot areas may be brought up to their normal rating or even safely overloaded within manufacturers' recommended limits (usually 15%) by means of this filtering type of air washer. The washer also prevents dust and lint from accumulating in windings where they may create fire hazards and deter circulation.

The average capillary air washer has the same cross sectional area as other types of air washers at velocities of 500 to 600 fpm, but for the same work, the length of a standard air washer is from 9 to 12 ft long as against 6 ft for a capillary air washer.

When a capillary air washer is provided with glass mat eliminators in place of metal eliminators, metal is conserved, and a chief source of trouble in a washer is eliminated. Glass mat eliminators can be removed readily and replaced without any field manpower, while metal eliminators are difficult to replace. The capillaries with glass mat eliminators are considerably lighter than ordinary two-spray washers and for shipment will usually pack to better advantage.

BLACKOUT AT SEA

Ship Ventilation under Blackout Conditions

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The subject of blackout is or has been important to most ventilating engineers. Ventilation of ships under this condition is not only an interesting study but also a very vital one, for the urgency of blackout on ships sailing the high seas these days is unparalleled. The accompanying article is the result of first-hand knowledge gained by the author within the last year while attempting to establish some standardization of requirements for merchant vessels.

LIGHT excluding ventilators were used on ships prior to the present conflict. However, the present war has emphasized the importance of absolute blackout or "darkened ship" operation for evading detection by enemy air, surface, or underwater craft.

The average ventilating engineer tends to minimize the importance of natural ventilation on board ship, because of the small size of airports as compared with the size of windows required by various building codes. Nevertheless, it should be remembered that even with a light beam or quartering breeze blowing, a 12-inch diameter airport will supply far more air than the average mechanical ventilation system, if provisions are made for cross ventilation. Furthermore, there are thousands of ships afloat which do not have any mechanical ventilation for living and working spaces, and which must rely entirely on natural ventilation. Airports, skylights, and other natural ventilators thus play a large part in ventilating most merchant ships.

Means for Providing Natural Ventilation

Skylights were probably one of the first means for providing air and light. On a ship they are used for exhausting hot air from engine rooms, boiler rooms, large public rooms, galleys, and pantries. Fig. 2 shows a typical skylight. The covers are normally fitted with circular glass ports to permit the passage of light when the covers are closed in cold or bad weather. The covers are raised and lowered by means of a handwheel, crank, worm, and pinion device, and the mechanism usually is designed so that two handwheels simultaneously operate all of the covers. Engine room skylights are built in one piece and are bolted in place. Such construction permits easy passage of large pieces of machinery through the opening when the skylight is removed. Also, small pieces of equipment can be passed through the individual openings in the skylight.

Airports serve as the ship's windows, permitting air and light to enter the space served. Scoops are commonly furnished, particularly where natural ventilation must be relied on for "guiding" the air into a room. Wind scoops have in the past taken many crude forms. Before they were furnished as standard equipment, they frequently were fashioned from five-gallon gasoline cans and "cabin" coffee cans by members of the crew. However, now the more refined article is made of sheet metal, hot-dipped galvanized after fabrication, and provided with a bronze insect screen and frame. Fig. 1 shows a standard pre-war type.

While small windows have been fitted in many passenger and some foreign cargo vessels, airports are more popular. The unpopularity of windows, aside from various structural considerations, undoubtedly is caused by the difficulty encountered in producing a reliable, watertight, inexpensive, easy-operating one. Today airports are not only used for providing air and light, but also for providing means for emergency escape. It is now general practice to provide at least a 16 in. diameter clear opening, except in a few instances where special requirements prohibit the use of such large openings.

Miscellaneous ventilators, such as propeller fans set in the side of a house, cowls, goosenecks, hoods, torpedo vents, and weather louvers, are also found on board ship. These openings must be made light proof if they serve spaces which normally are illuminated and occupied at night. In many such cases, however, no fixed procedure is followed, and the necessity for providing light-excluding features depends on the proximity and intensity of light in each particular case. Frequently, decisions are reached only after installation and service inspection determine the steps which are required. It should be noted that in most cases cowls need only have the interior painted dull black to make them light proof. This is caused by the fact that they usually are

connected to long ducts (straight or slightly offset) which are also painted black inside.

Engine Room Blackout

Blacking out of engine rooms, when first introduced, seriously impaired working conditions. The skylights, which form the principal means for natural exhaust on most merchant vessels, were not light tight. The first solution was to close the skylights at night and eliminate or paint over the glass deadlights. This seriously retarded the liberation of heat from the space, particularly on vessels having only natural ventilation.

Wishful thinking alone can be considered the motivating power for many of the early attempts made to alleviate the bad conditions thus caused. One such idea consisted of installing a few small cowls or mushrooms in the peak of the skylight. In one particular case, cowls having an area of about six square feet were installed in the peak of a skylight with a total area of at least sixty square feet. Another idea consisted of building a louvered framework around the skylight, as shown in Fig. 3.

Probably, the most practical emergency cure was the installation of Z-shaped baffles in the skylight openings (see Figs. 4 and 5). Because of interference between the blackout louvers and the operating gear on the skylight, the installation was more or less complicated. In some cases the lifting gear

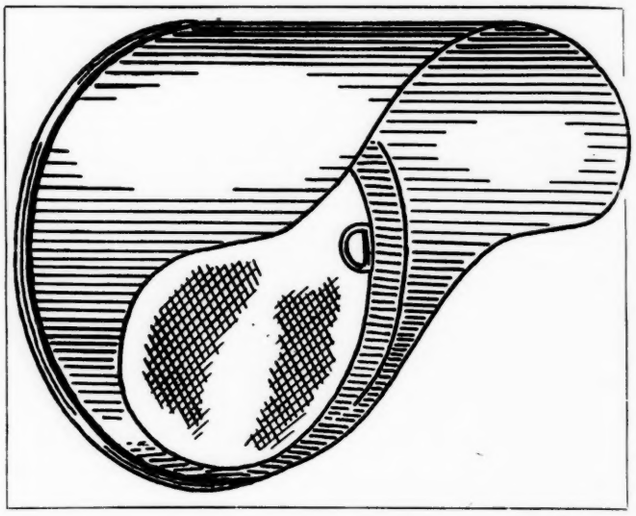


Fig. 1. Typical Wind Scoop used before blackout became essential. Note that the insect screen is removable. These ventilators are usually furnished hot-dip galvanized.

itself was completely redesigned, as shown in Figs. 6 and 7. For these reasons, and the fact that the baffles unduly impaired the natural flow of air as well as natural illumination, the conclusion was reached that the skylight was not a satisfactory device for furnishing light and air under war conditions.

At first a mushroom ventilator was considered to be an improvement. However, before steps were

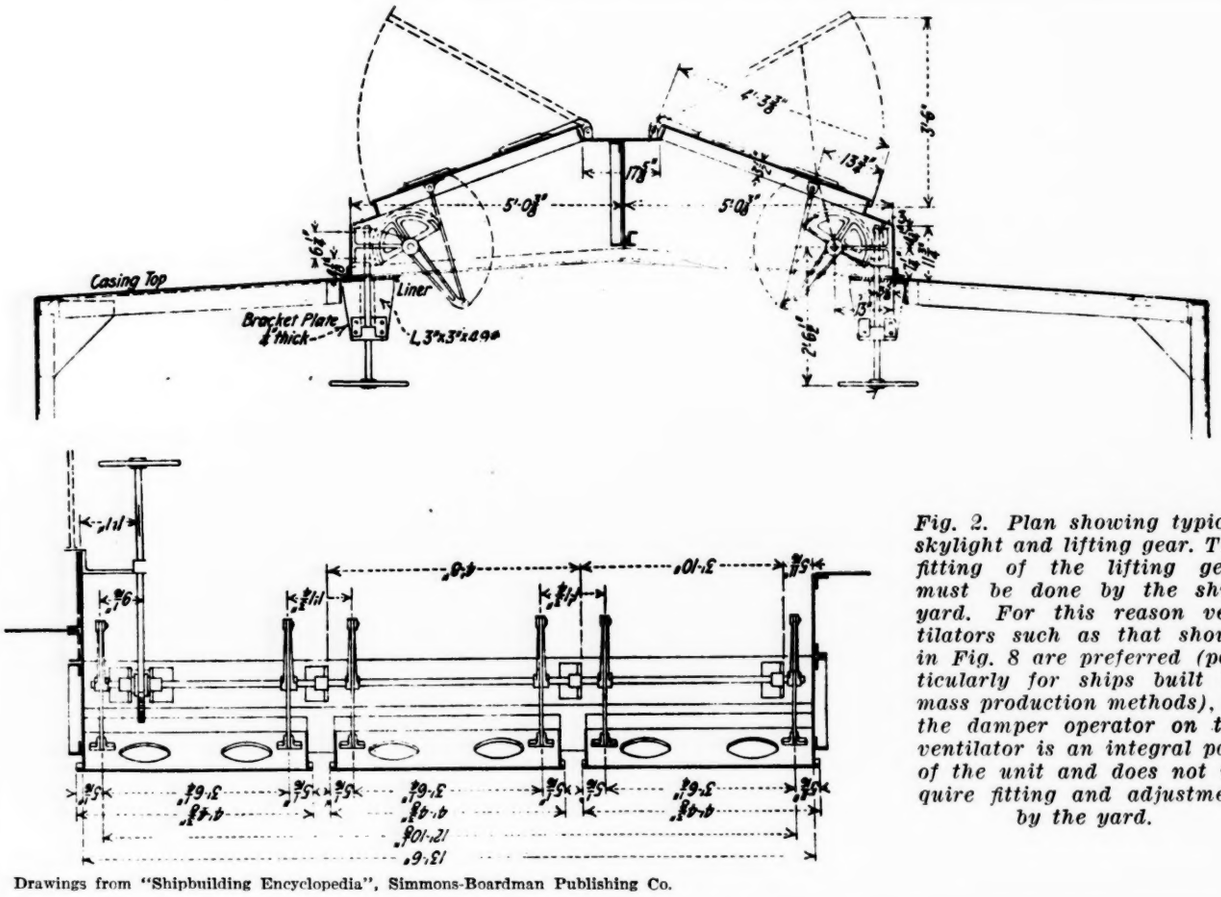


Fig. 2. Plan showing typical skylight and lifting gear. The fitting of the lifting gear must be done by the shipyard. For this reason ventilators such as that shown in Fig. 8 are preferred (particularly for ships built by mass production methods), as the damper operator on the ventilator is an integral part of the unit and does not require fitting and adjustment by the yard.

Drawings from "Shipbuilding Encyclopedia", Simmons-Boardman Publishing Co.

taken in this direction, the ridge type ventilator, shown in Figs. 8, 9, and 10, was introduced and accepted because of its inherent superiority. This ventilator is both weather and light proof and also performs better as a natural ventilator. In addition, it is built in one piece (complete with dampers and operating gear) and shipped to the yard ready for installation. However, the skylight lifting gear must be fitted on the ship after the skylight is in place. The damper operator on the new ventilator is much easier and quicker to operate, and it is not necessary to close the ventilator except in most severe weather.

All in all, the new ventilator may be said to be cheaper, lighter, better performing, and easier to operate than the skylight with light-excluding louvers. The proof lies in the fact that it was wholeheartedly accepted by those concerned.

Airports — Natural

The lowly airport, so frequently condemned as unsuitable for ventilation, can now raise its head once again, for this war has reminded us that the best ventilation for sailors is a fresh breeze through an open porthole. This is just another case in which those who knew better died, and those who succeeded them forgot or never knew what the deceased had taken a lifetime to learn.

Before the war, merchant vessels were not concerned with the problem of blackout, except in a few cases where it was necessary to extinguish certain lights in order to assist navigation at night. Naval vessels were provided with light-excluding devices in airports and ventilation openings. In general no definite tests were established except visual inspection after installation. The Navy developed a standard porthole light-excluding louver in 1936. This design was selected from numerous ones proposed after a series of air and light tests. The louver consisted of a series of parallel "Z" shaped baffles secured to a cylindrical frame suitable for inserting in the airport.

The first porthole blackout ventilators used on merchant vessels employed the same design baffle, but, in order to simplify construction, the baffles were set in the largest square which could be accommodated by a cylindrical frame slightly smaller in diameter than the airport. This type was usually manufactured by the shipyards. Why it was not retained when the demand increased and numerous private sheet metal shops began to make them, is not clear.

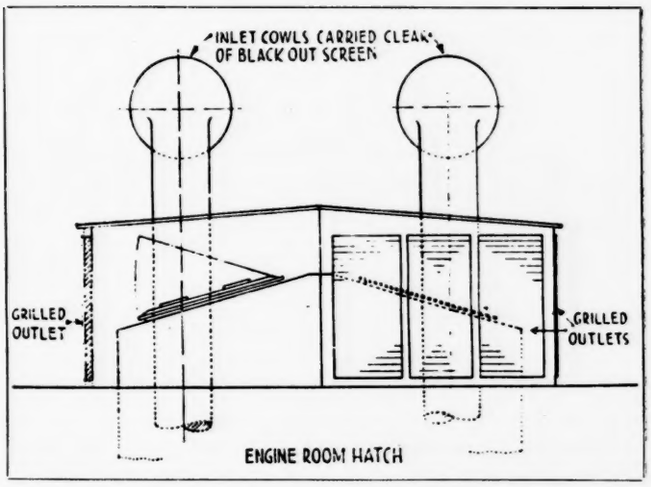
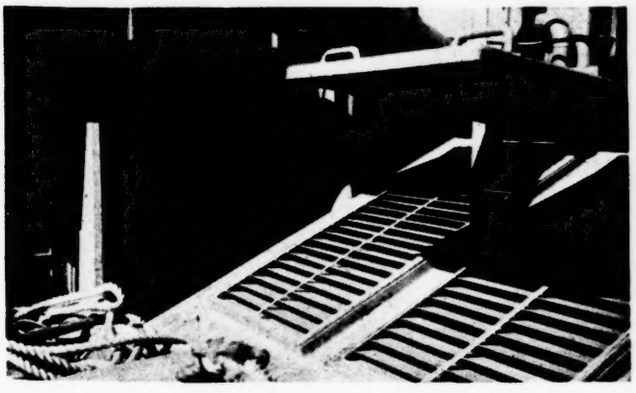


Fig. 3. This type of blackout structure is frequently made of wood, thus forming a serious fire hazard. Drawing from "Ventilation of Ships' Machinery Spaces" by J. K. W. MacVicar, in Nov. 4, 1943 issue of "Shipbuilding and Shipping Record." Paper presented before a meeting of the Institute of Marine Engineers (England)

Most of the early manufacturers of the "commercial" type of blackout ventilators did not consider the matter of performance as much as they did the simplicity of construction in order to reduce the cost. In all cases, the performance was very inefficient—to say the least. In some cases, good light-excluding properties were obtained.

Numerous designs were used by the various man-



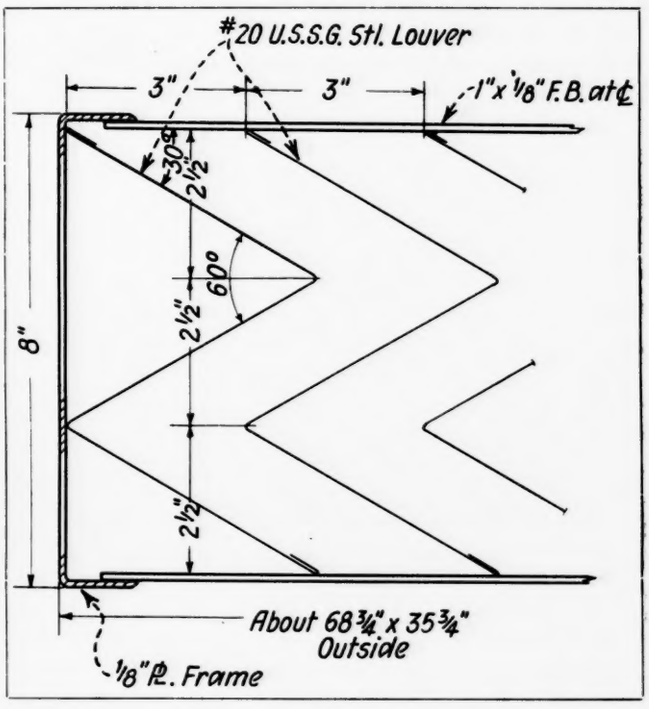


Fig. 4. (Left) Blackout baffles in conventional skylight. Note the "scooping" effect of the baffles which will cause a backdraft with beam winds. Fig. 5. (Right) Longitudinal section of blackout louvers shown in Fig. 4.

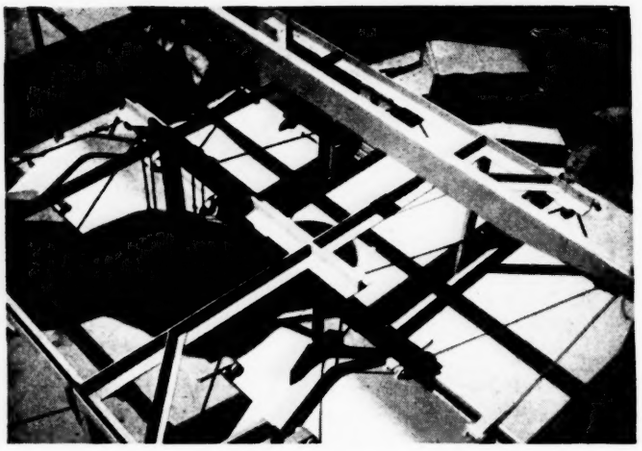


Fig. 6. A type of skylight lifting gear designed to avoid interference with blackout louvers in skylight openings shown in Fig. 4. Note louver in upper right hand corner which was removed during a test to determine the resistance offered by this blackout feature. This arrangement was developed before the ventilator shown in Figs. 8 and 9 was introduced.

ufacturers. Figs. 11 and 12 show two of the earliest types. Just why the blackout louver business attracted so many manufacturers is not known, although it may be that the "apparent" simplicity of the job plus large profits for rapid delivery was the inducement. No definite requirements were set up in the earlier stages, as the blackout louvers were specified by those in charge of the outfitting rather than those interested in ventilating the ship. However, a few of the more enterprising manufacturers submitted their units to test by various laboratories in order to show the superiority of their design. Unfortunately, no standard test was used, and, therefore, a comparison of results from any two laboratories was impossible.

The matter of establishing acceptable performance was difficult in the beginning because no one knew just what amount of air and light could be obtained with the specified standard test. Standards were first set at 90 cubic feet per minute average of nine readings and 0.002 foot-lamberts maximum light leakage (or brightness). Early practical tests showed that this original light value was too conservative, and it was then increased to 0.070 foot-lamberts. Most manufacturers were skeptical as to the possibility of meeting the above requirements with inexpensive construction. However, the improvements in performance which resulted soon proved astonishing to all concerned. Fig. 13 shows the first unit satisfying the above standards. The earliest models —thousands of which were used—delivered not over 60 cubic feet per minute, and some below 40 cubic feet per minute. At the present time, deliveries over 200 cubic feet per minute are not uncommon. In other words, the performance has been improved well over 300% by merely establishing a definite standard for comparing performance. It is also interesting to note that in very few cases does the light leakage value even approach the present allowable maximum. Fig. 14 shows a 12-inch unit having an air flow exceeding 175 cubic feet per minute and a maximum brightness of 0.005 foot-lamberts.

It appeared at first that high performance standards would greatly increase the cost of these units. While this factor was not considered essential, nevertheless the cost of the improved designs is only slightly, if at all, higher than the earlier ones which only could be considered a waste of good steel and labor in most cases. Strange as it may seem, all good designs, with one exception, have fundamentally the same baffle arrangement as the original Navy unit.

One new feature, introduced since the war began, which improved the effectiveness of porthole blackout ventilators, is the incorporation of means for turning the scoop without removing the ventilator from the airport. The original scheme (see Figs. 11 and 12) consisted of a circular channel in which the scoop and louvers could revolve. However, hard operation due to rust and "out of round" construction made this particular arrangement undesirable. A simple loose ring construction now has become more or less standard. This improvement is clearly illustrated in Fig. 13.

The standard test code for porthole blackout ventilators is based on a 14-inch diameter airport. However, until very recently, a 12-inch diameter port was most common. As previously mentioned, present conditions have made it imperative to use 16-inch diameter airports in order that the opening may be used as an emergency escape.

The average 12-inch porthole blackout louver with scoop and screen weighs about 12 lb. The weight of the 16-inch unit is about 22 lb. Based on proportionate areas, the larger size will deliver 265 cfm, if we establish a minimum requirement of 150 cfm for the 12-inch size. A question frequently discussed is whether or not the minimum requirements should be set on the basis of capacity of "a unit for a 16-inch airport" rather than "a 16-inch unit for a 16-inch airport." The omission of the louver size will encourage greater development, because the manufacturer producing the most efficient design can furnish

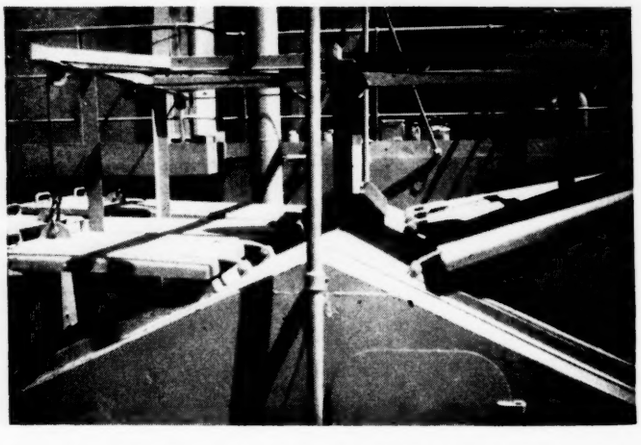


Fig. 7. Another view of the skylight shown in Fig. 6. Note cables and pulleys. The door in the foreground is for emergency escape.

the smallest and lightest unit, thus reducing his costs. The argument against this practice is that under certain circumstances you can never secure too much ventilation. Considering the negligible efficiency of the earlier designs, the writer tends to favor the capacity requirement regardless of size, because it encourages high performance without excluding the majority of reputable manufacturers, and will produce units which are lighter and more easily handled.

One should not draw the conclusion that further development of porthole ventilators is unnecessary. On the contrary, the experiences of the last few months merely indicate that the limit of perfection is still to be attained. For instance, one point which has not been investigated fully is the relative effectiveness of various scoop designs and lengths. It is obvious, from the extreme variations between the models submitted by various manufacturers, that the scoop proportions are now more or less haphazard selections.

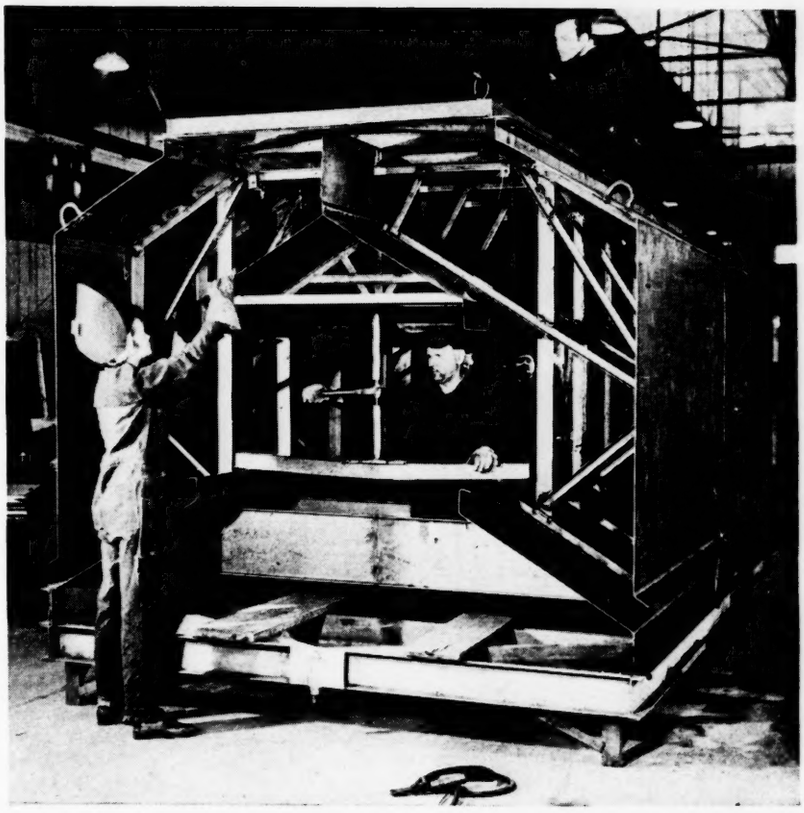


Fig. 8. Assembly of H. H. Robertson Co. ventilator for a Liberty ship. A combination damper-baffle is later installed to ease the air flow and permit the ventilator to be closed partially or fully when desired.

Airports — Mechanical

The use of airports for natural ventilation is as old as the hills. As previously mentioned, its use with an air scoop came next, while the addition of the blackout feature may be considered relatively new. The restricting effect of the blackout louver, particularly the earlier ones, emphasized the inadequacy of such a device where natural ventilation only was available.

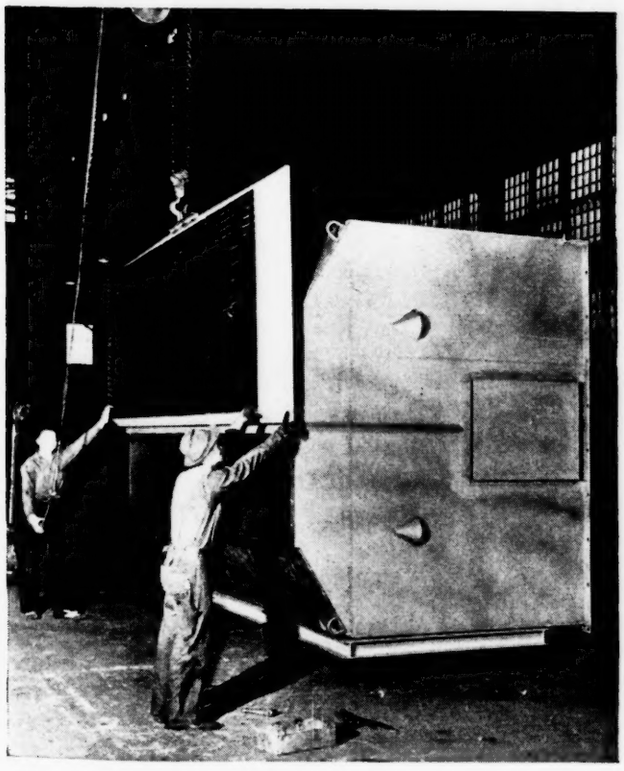


Fig. 9. Robertson blackout ventilator being assembled. The blackout baffle is being lowered in place. Rectangular frame on the right end is for an emergency access door.

Prior to the war, Victor J. Cucci* experimented with the idea of improving the ventilation of vessels in service by fitting fans into the airports. On several occasions, certain passenger vessels which had been operating in the North Atlantic trade were transferred to tropical routes. This shift naturally caused serious complaints of inadequate ventilation. Mr. Cucci's idea was to supplement the existing mechanical ventilation systems with supply fans for drawing air through the airport.

When the war first began it seemed that the development of this scheme would be retarded until the passenger trade again became active. This thought, however, was short lived, because the war brought with it serious limitations to the conventional methods of ventilation.

The Maritime Commission agreed to furnish a number of small coastal cargo vessels for Lend-Lease, which were to be duplicates of a British design. These vessels had only natural ventilation. Unfortunately, most designers in this country had become so accustomed to providing mechanical ventilation, that the art of designing natural systems had been lost. Also, seemingly minor changes in the duplicate vessels plus the necessity for elimin-

*Victor J. Cucci, Chief Engineer, Ventilation Department, Office of George G. Sharp, Naval Architect, 30 Church Street, New York.

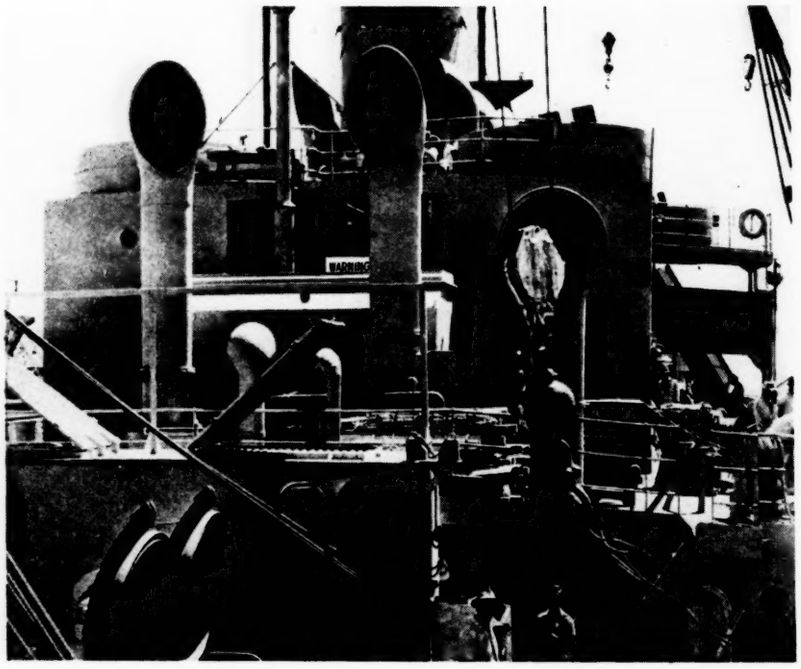


Fig. 10. On board a Liberty ship showing the large cowls used for serving the engine room. A Robertson engine room ventilator may be seen in the background. In the foreground there are two small skylights fitted with Z-shaped blackout baffles.

ating obstacles on the deck, which could be tripped over while working ship under blackout conditions, seriously limited the feasibility of natural ventilation. While working on the ventilation of these vessels, Mr. Cucci conceived the idea of combining the original airport fan with the porthole blackout ventilator, so as to supply air to the space served, exhaust air from the space, and recirculate the air in the space under blackout conditions. The idea also incorporated partial recirculation and supply of air simultaneously.

Mr. Cucci's scheme was presented to the Ilg Electric Ventilating Company for development. The project progressed for several years before a mutually satisfactory design was developed. During this time numerous test models were put through their paces. Also during this time, the standard tests for light leakage through porthole ventilators were developed. This coordinated effort resulted in a rugged, fool-proof, quiet, efficient device capable of standing up to the abuse of marine service and also capable of being manufactured at a reasonable price. The horsepower required to operate this porthole ventilator is about the same as that required by the conventional bracket (recirculating) fan which it replaces. Figs. 15 and 16 show a late model of a mechanical porthole blackout ventilator.

The production of a practical interpretation of the aforementioned scheme required that numerous problems be solved without making the overall cost prohibitive. Although appearance is seldom considered essential to the design engineer, particularly for utility items, it takes one but a glance to appreciate the compactness and smooth appearance of the design finally offered to the marine industry.

At the present time, only experimental units have been tried out on ships. However, arrangements have already been made to fit out at least 800 vessels with mechanical porthole blackout ventilators. It, therefore, appears that this method of ventilation is very suitable for living spaces on merchant vessels, which are reasonably well protected from direct contact with the sea. This is particularly true today with mass production of ships, because the units can be installed at the last minute after all work but the finishing touches has been achieved. Also, no elaborate testing is required.

While the porthole blackout louver is not considered waterproof, it is weatherproof, for the vertical light baffles also tend to eliminate rain and spray. Furthermore, the mechanical unit may be operated as an exhaust fan during bad weather in order to retard the inflow of moisture. It is apparent that under certain adverse weather conditions the airport must be closed when ventilation is desirable. However, such conditions normally exist a minute portion of the time on merchant ships. Furthermore, many other types of natural ventilators, such as cowls and mushrooms, are also inoperative under these conditions.

Standard Porthole Blackout Ventilator Test

It has been mentioned above that a large variety of porthole blackout louvers are now available.

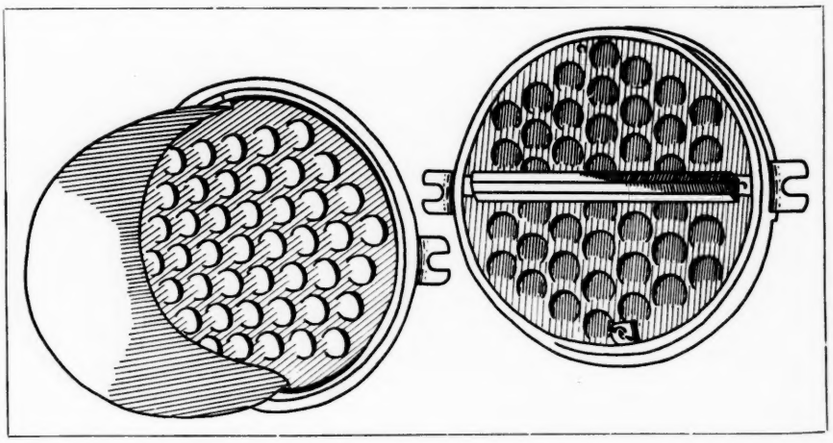


Fig. 11. Views of one of the earliest commercial types of blackout louvers manufactured and approved before standard requirements were established. The air flow was negligible, and the turning mechanism frequently became inoperable due to corrosion between the faying surfaces.

While in many cases the superiority of certain ones is rather obvious, experience has indicated the absolute necessity for setting up a standard test procedure.

Early specifications were vague and inadequate. The light intensity on the room side was sometimes included, but the term "no light" frequently appeared without qualifications. A review of light and air tests made by various laboratories soon elicited the fact that a very specific procedure was required to obtain suitable data for comparing various designs. Obviously, too, this condition eliminated the possibility of comparing results in order to determine the variation due to the technique of the investigators.

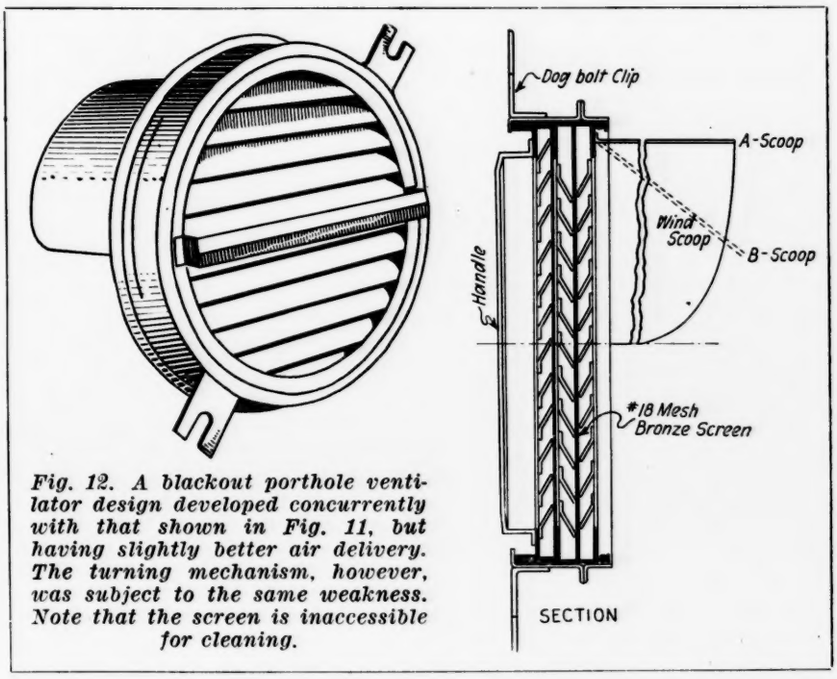


Fig. 12. A blackout porthole ventilator design developed concurrently with that shown in Fig. 11, but having slightly better air delivery. The turning mechanism, however, was subject to the same weakness. Note that the screen is inaccessible for cleaning.

Considerable difficulty was encountered in developing acceptable light leakage standards. Various authorities differed in their recommendations, and furthermore the terms used were strange to the ventilating engineer. The first step was to determine what light leakage would be satisfactory. It was soon found that the term "no light" had no practical significance. It also was evident that any standard which depended on individual interpretation lost its ability to produce the desired uniformity. The test procedure, therefore, consists of applying a "magnified" assumed "maximum" brightness to one side of the ventilator and measuring the maximum brightness on the opposite side. The acceptable maximum brightness thus measured bears a definite relation to that brightness (or dimness) which will not be visible at sea (when the observer is at an arbitrarily fixed distance from the ventilator) with an arbitrarily assumed maximum brightness in the ventilated space.

Having thus arrived at an acceptable standard of light leakage (or brightness), the ventilation engineer was again free to experiment with various baffle forms and arrangements in order to determine the most efficient design capable of being produced most economically.

The standard test for ventilators set up by the Maritime Commission test has been accepted by several government agencies. It applies to ventilators furnished with or without a scoop, but the air flow test is always made with a scoop. Ventilators, other than the 14-inch size specified frequently, are tested because of convenience or because some requisitions include testing of the particular size involved. Comparisons are made on the basis of proportional gross louver area. The air flow test data obtained are useful for comparing various designs. However, it should not be assumed that comparable performance will be obtained on board ship, because the location of the porthole, means for exhaust or cross ventilation, and similar factors will greatly affect the performance in service.

The fact must be understood that testing a porthole blackout louver does not make it acceptable. The test merely provides information for comparing its performance with other units. Furthermore, the

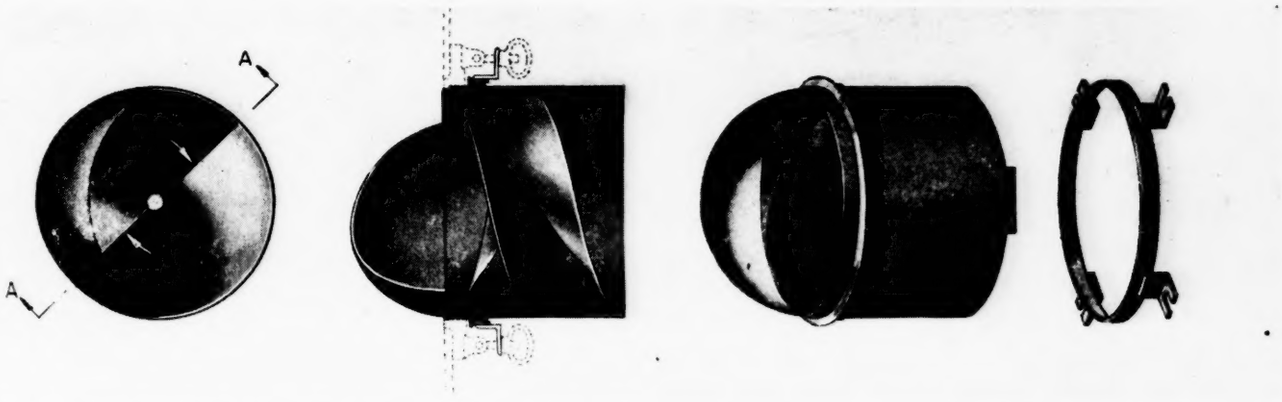


Fig. 13. First blackout porthole ventilator complying with standard test requirements. Note the loose "pressure" ring for securing the louver in place which overcomes the weakness of the earlier models. Illustration courtesy Rambusch Decorating Co., New York.

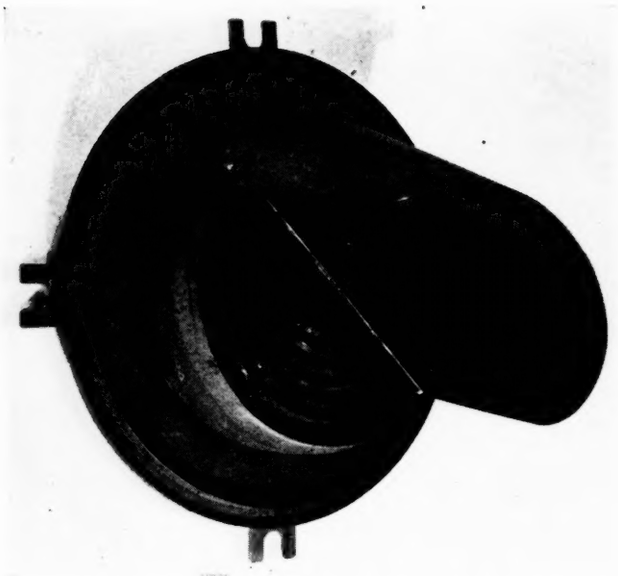


Fig. 14. Latest type Rambusch porthole blackout louver. Photo courtesy Rambusch Decorating Co., New York.

above test is only concerned with the light-excluding and air-flow characteristics of the ventilator. Construction, reliability, and other necessary qualities of a good product cannot be judged from the test results, and poor workmanship can make the best design useless.

Standardization

The subject of standardization can be well appreciated by the manufacturers of porthole blackout louvers. Perhaps this viewpoint can be illustrated most easily by the accompanying table showing an actual example of the various types and sizes furnished by one manufacturer for a certain vessel.

In addition to variations in diameters for round ports, many ships have flat oval and square airports. Also some airports have patented hinging devices, which call for special attachments.

The number of different airport designs used on merchant vessels before the war was equal to the number of shipyards multiplied by a factor greater

TYPICAL LIST OF PORTHOLE BLACKOUT VENTILATORS SUPPLIED FOR A TROOPSHIP CONVERSION

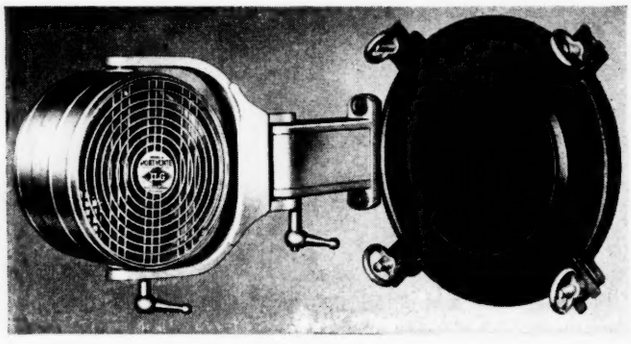
(Based on information furnished by Rambusch Decorating Company.)

Quantity	Type	Porthole Dia., In.	Number of Airport Lugs	Type of Scoop
1	F	9	2	Full
12	C	12 7/8	2	Full
16	C	12 7/8	2	Short
19	C	12 7/8	2	....
5	E	14 1/8	4	....
27	D	14 3/4	2	Short
8	D	14 3/4	2	....
26	B	16 1/8	4	Full
11	B	16 1/8	4	Short
9	B	16 1/8	4	....

than one. The naval architect in charge of the Commission's emergency shipbuilding program soon realized that it was essential to standardize many details. The basis for this realization was the fact that a number of yards would have to construct identical ships of material obtained by a central procurement office. The airports received particular attention, because they were purchased from numerous vendors, and, therefore, had to be interchangeable to fit properly on all vessels. Also, pre-war airports were made of cast brass, which soon had to be replaced by malleable iron or steel castings. These castings also became critical, and pressed steel airports were proposed. A reinvestigation of the problem indicated that a simple fabricated steel airport design was more practical. Simultaneously with the introduction of the steel airport came the realization that larger airports were essential to provide means for emergency escape. Thus, the standard size was then increased from a 12-inch diameter to a 16-inch diameter.

The Maritime Commission has encouraged the use of a standard 16-inch fabricated airport for all vessels, in order to insure uniformity, accelerate production, and eliminate the numerous differences inherent to the old-fashioned cast type. This in turn makes it possible to standardize on a porthole black-

(Concluded on page 100)



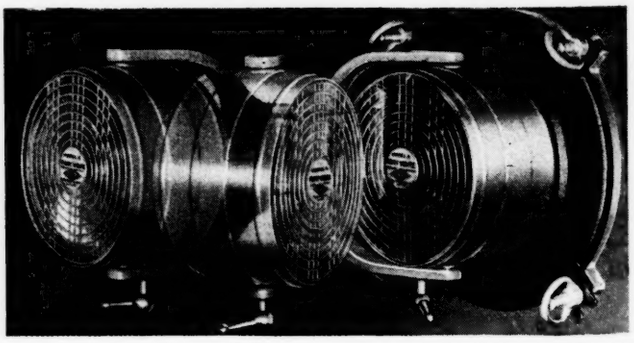
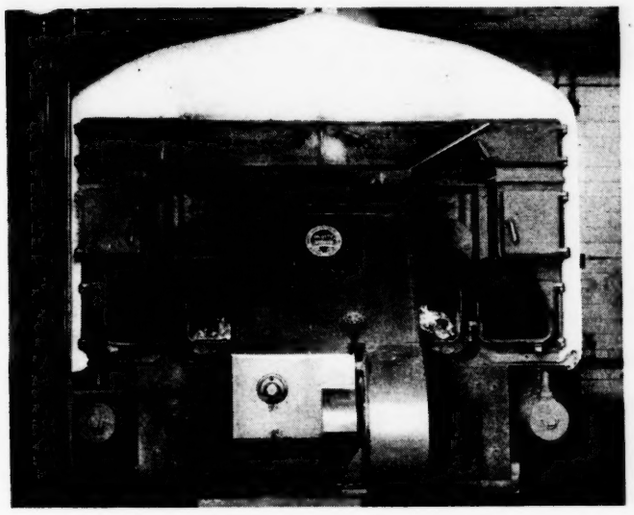


Fig. 15. (Left) Ilg Electric Ventilating Company mechanical porthole blackout ventilator. The ventilator is normally installed with louvers vertical so that rain and spray will drain off and not pocket in louver. The switch and speed control on this model is housed in bracket. This unit delivers 300 cfm (in position for supply or exhaust) through the louver having a maximum brightness less than 0.010 foot-lamberts. Fig. 16. (Right) Another view of the Ilg ventilator. The fan is shown in three positions: (A) supplying or exhausting when installed directly in the airport. (B) partially supplying and recirculating when installed slightly away from the airport and directed at a desired point. (C) one of the full recirculating positions when airport may be closed in very severe weather and blackout louver is removed. In the latter position 600 cfm is handled

Added Process Steam Load Solved by Increased Pressure

F. N. HOLLINGSWORTH

A PROMINENT part of Connecticut's great machine tool industry is the New Britain Machine Company, New Britain. This company's plant has expanded rapidly during the past three years. Its expansion program was planned for future growth



One of the H. B. Smith boilers used by the New Britain Machine Co.

by constructing a group of buildings on the outskirts of the city, well away from the city's highly congested business center, and with plenty of land for additions.

Due to the fact that the buildings are somewhat widely separated and that priority could not be obtained for the Central Plant Extension desired, the structures were heated by individual boiler plants using cast iron sectional boilers.

Two of the new buildings are designated *W* and *V* and are one-story structures of reinforced concrete, with brick curtain walls, no skylights or monitors.

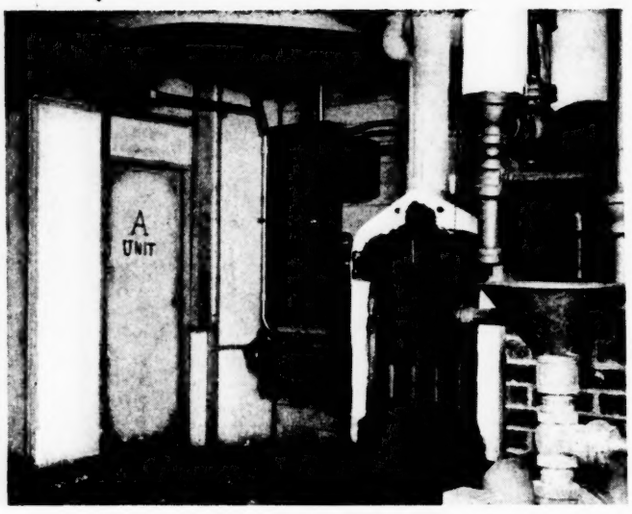
The *W* building is 160x400 ft with six 20-ft bays and one 40-ft bay. The building has an ell or wing on one side 25 ft wide and 300 ft long housing rest rooms, toilets and boiler room. This building has a floor area of 71,500 sq ft and a cube of 1,205,000 ft. The *V* building is 320 ft x 120 ft, being six bays wide. It has an ell or wing 25 ft wide and 200 ft long with toilets, rest rooms and boiler room. This building has a floor area of 43,400 sq ft and a cube of 660,000 feet.

Two 17-section No. 60 H. B. Smith cast iron boilers of water tube design provide the heating plant in Building *W*, and two 15-section No. 60 Smith boilers of the same type are installed in Building *V*. Each building has a large Whitty hand-loaded stoker for each boiler, using run-of-the-mine bituminous coal. Each plant is equipped with a duplex vacuum and pumps and Powers automatic controls. Each structure has a radial brick chimney 75 ft high based in the boiler room.

Steam for heating is supplied to the two large coil chambers of the fresh air fan unit assemblies located in the boiler rooms. From the coil chambers, heated air is blown through grilles into the factory by motor driven fans with variable speed drives. In the *W* building the two units each have a maximum capacity of 40,000 cfm and 3,000,000 Btu. In the *V* building each of the units has a capacity of 20,000 cfm and 2,000,000 Btu. Fans deliver air at a maximum velocity of 4500 fpm. At top speed the resulting noise is too much even for a factory and the fans are operated at reduced speeds.

After the buildings were completed, more steam was needed for degreasing equipment and at a somewhat higher pressure. This problem was solved by raising the boiler pressure above the 15 lb ordinarily

Corner of one boiler room showing the Whitty stoker feed, and the stack base inside the boiler room.



Left, heat distribution chamber; right, domestic hot water tank and auxiliary heater.

considered tops with cast iron sectional boilers.

Sufficient boiler capacity was available to handle this extra load, as well as peak heating requirements. Since the cast iron boilers are the water tube, independent header type, they can be used for steam pressures up to 25 lb should the process equipment require that higher pressure steam be employed.

Domestic hot water in each building is supplied during the winter by a steam coil located in a 300-gal tank in each building, delivering 20 gpm. When the main boilers are not operating through the summer, hot water is supplied by a No. 17 Hi-Test H. B. Smith hot water unit, installed beside the tanks. The 150 lb pressure from city mains is reduced to 50 lb for the hot water supply.

An interesting building of the new group is the cafeteria, which was, in order to save critical materials, constructed of wooden forms used to erect the *W* and *V* plants. This unit is also heated independently by an H. B. Smith 15-section No. 44 Mills unit which also supplies steam for cooking and hot water.

The two independent plants have compact boiler room layouts, with the short runs of heating ducts and the stack at one side of the boiler rooms all located in the service ell of each building. Ash disposal is nominal, by means of a small dump door through the boiler room wall to the outside.

Architect, designer and general contractor for this dual project was the Morton C. Tuttle Company; utility engineers, Richard D. Kimball Company, and the heating contractor, the V. J. Kenneally Company, all of Boston, Mass.

The Odor Of Sanctity

IF "cleanliness is next to godliness," the odor of soap should, within a few "shades," approach the odor of sanctity; that is, when the soap is fresh. Decaying soap is an entirely different matter.

Being of an organic basis, if exposed to suitable conditions, oxidation will take place and the products of oxidation of animal or vegetable matter have an effluvium all their own, as is evidenced by the respectful distance from which the familiar municipal garbage truck is viewed.

Not infrequently, soap suds from laundry apparatus are spilled on the floor and, if they get into some crevice or pocket (a pipe trench is almost ideal) where they are kept warm and moist with not too much light to inhibit bacterial action, the occupants of the building have reason for self congratulation if each and everyone of them is not demanding that the deceased animal be removed at once and given proper burial, for the resulting odor has peculiarly penetrating properties.

While it is true that drainage systems have no direct connection with heating and ventilating systems, it is quite possible that the short-comings of the former may be laid upon the door step of the latter, since an odor, no matter what its origin may be, should be introduced into the supply duct system via recirculating connections, will be delivered to all parts of the building served by the system.

Though the suds from the laundry do not run over the floor, if a pipe trench drain should be connected, even indirectly with the drain from the sump under a washing machine, make sure that, when the washer is emptied, there is no sudden surge through the connecting lines into the trench.

It may be advisable either to have no drains in a pipe trench or else so to design the drainage lines that such drains cannot be subjected to back surges due to momentary overload of other floor drain lines.

Do not depend too much upon backwater valves; there are many good ones on the market, but, no matter how carefully designed and constructed they are, conditions can easily arise such that, through no fault of the valve itself, it will not close tight.

Another possible source of objectionable odor is organic matter which may be deposited in the pits in Travertine Marble, when used as a floor, unless the cavities are kept filled by periodic grouting.

In many buildings, sweeping compounds are used and most of these are, or contain, organic matter.

One particularly annoying condition arose from this cause. The sweeping compound, pocketed in the pits in the stone, lay there and decayed.

In the early morning, before the building was opened, the odor in the Lobby was almost nauseating. This presently passed away and by mid-forenoon it was hardly noticeable. Next morning, however, it was as good, or better than ever.

The only remedy for this condition is to have the floor thoroughly cleaned and the pits in the marble properly filled with grout.—*John J. Woolfenden, Engineering Staff, Smith, Hinchman & Grylls, Inc., Detroit.*

WASHINGTON NEWS

Summarized by Loring F. Overman; The Metals Situation Eases Slightly; Valve Restrictions Are Partly Lifted; Volunteers Sought for Coal Program.

Of considerable early significance to those engaged in designing, engineering and manufacturing phases of the heating, ventilating and air-conditioning industries, is the fact that the War Production Board will soon announce what might be called a "de-substitution" program.

Whatever the program may be called, it simply means that manufacturers of many types of equipment will soon be permitted to resume their normal use of metals, and that the continued use of often-unsatisfactory substitutes will not be required.

To date, 65 "L" and "M" Orders —Limitation and Conservation Orders—have been reviewed and the indicated de-substitution has been authorized. The WPB Requirements committee has approved the release of the necessary quantities of metal to permit immediate revision of half a dozen of the orders, and revision of the others will follow as soon as material allocations can be made.

Just how many of the orders will affect heating, ventilating and air-conditioning industries could not be ascertained at press time, but indications are that several will be involved. Order L-75, for example, establishing controls over the construction of stokers, will be revised to include, among other things, provision for 200,000 pounds of zinc for castings. L-22, having to do with warm air furnaces, is to be revised to permit use of normal components in linings. Order M-21, covering cast iron soil pipe, has been amended to lift restrictions, and 32,000 tons of cast iron has been allocated for construction purposes. Schedule IV of Order L-42, having to do with simplification of plumbing equipment, is to be revised.

The foregoing represent "only the beginning" of a program significant for three reasons. First, it offers tangible proof that the peak has been passed in the military construction program, thereby releasing metals previously regarded as critical. Second, it should simplify the task of designing engineers by permitting a return to the use of time-tested materials and methods. Third, by permitting the resumption of the use of materials with which the trade is familiar, it will offer a head-start toward capacity civilian production when victory permits a complete return to normal distribution.

Program Has Strings

It should not be concluded that the revision of the limitation orders will permit any increase in production of equipment for civilian use. Military circles are still adamant in their position that such increases must await the outcome of 1944 military operations. What, then, is the purpose of releasing metals that will simplify manufacturing processes and permit increased production with reduced manpower?

Right there, in the question of manpower, is the meat of the coconut. Producers of scores of items of equipment have contended that the required use of substitute materials has cost more in manpower than it has saved in critical materials. Many have offered figures to prove that thousands of skilled men could be released to more essential war work if industry could be relieved of the necessity of using hard-to-work substitute materials, some of them not too well adapted to continued service. It has also been contended that the required use of substitutes not as good as previously used metals has resulted in breakdowns, need for additional repair parts and servicing, and a constantly snow-balling demand for manpower.

The idea has been so well sold that WPB has been convinced, and the major purpose of revising 65 or more restrictive orders is to release to the war effort, manpower that is reportedly engaged in tasks that would be unnecessary if "re-substitution" of metals formerly regarded as critical is permitted.

Thus, it appears, the first manufacturers to be permitted to take advantage of the "re-substitution" program will be those who convince WPB that they can release manpower if allocated certain materials. The net result, then, will be the same number of units of a given piece of equipment—but with fewer man-hours involved, and, presumably, with less necessity for repair services and replacement parts.

Stoker Committee Angle

Typical of the way manufacturers feel about the present program requiring substitutes is the February report to WPB by the Stoker Manufacturers Industrial Advisory Committee. Members reported on February 15 that although coal stokers of the type required to heat large apartment buildings are available in reasonable supply, they have recently concentrated on the repair of existing stokers, which has increased the demand for spare parts. They also reported that return to normal metals will reduce the needed quantities of replacement and maintenance parts made necessary by the unsatisfactory performance of alternate materials.

Postwar Aerosol

As previously reported in this column, the air conditioning industry's biggest competitor for existing supplies of Freon has been the Army's aerosol program, which seeks to eradicate the malarial mosquito wherever it attacks fighting men. It had been assumed that when the war ends, the demand for Freon would also return to normal. Knowing that by September 1 production of Freon will have been expanded to 4,800,000 pounds per month—four times normal peacetime production —some had begun to wonder what to do with the peacetime surplus.

Now, it is suggested by the Department of Agriculture, any surplus might profitably be employed in the treatment of plants with growth-control substances to secure seedless fruit from unpollinated flowers, to prevent premature fruit drop, and for other horticultural purposes. The suggestion is offered by three U. S. Department of Agriculture scientists, C. L. Hammer, H. A. Schomer and L. D. Goodhue, on the basis of experiments performed at the department's experiment station at Beltsville, Md.

Aerosols are solutions of chemicals in some readily evaporated liquid in a container kept under relatively high pressure. When the pressure is released the liquid is ejected into the air in an exceedingly fine mist, carrying the chemical with it. Aerosols have been found many times more effective than ordinary sprays

as a means for diffusing chemicals through space.

An aerosol of naphthoxyacetic acid, one of the plant-growth promoting substances, released in a closed space containing a number of flower but unpollinated tomato plants and left with them for 16 hours caused the setting of a high proportion of fruits, while untreated controls set very few. The aerosol-treated tomatoes ripened larger than the less numerous controls and were all seedless. It was even found possible to get tomatoes to set fruit in the open field when the aerosol was released in the immediate neighborhood of their flowers.

Further experiments are in progress, and it may be that by the time the Army's insect-killing program is over, agriculture will be ready to take up any Freon slack not required by refrigeration and air-conditioning equipment.

Advisory Committee Meets

In the meantime, April 1 has been set for the opening of a new Freon production plant at Deepwater, N. J., to produce 1,800,000 pounds per month, and September 1, for the plant at East Chicago, Ind., where monthly production will amount to 2,000,000 pounds. Reports on progress of the plants were given members of the General Refrigeration and Air Conditioning Industry Advisory Committee, meeting February 11 at Washington, D. C.

Members of the committee were told that WPB does not have under consideration any programs of easing restrictions on the manufacture of various prohibited items of air-conditioning and refrigeration equipment such as display cases, beverage coolers, comfort cooling machinery and other items.

Valve Restrictions Lifted

Many simplification and standardization requirements have been eliminated in the manufacture of radiator supply valves, low pressure thermostatic radiator traps, combination float and thermostatic traps and boiler return traps, WPB reports.

The amended schedule provides that any copper base alloy used in the production of bodies for radiator supply valves shall be made without the use of any primary copper or tin and shall be of no higher grade than a maximum of 86% copper and 6% tin.

No packless radiator supply valves may be produced with metallic bellows or diaphragms according to the amended schedule, but such valves may be made in any type or pattern; and there are no restrictions as to size. Previously, only one type, the spring-packed radiator supply valve, was permitted for each manufacturer.

Former restrictions as to sizes, designs, patterns and types of low pressure thermostatic radiator and drip traps, combination float and thermostatic traps and boiler return traps have been removed except that the bodies of these items are still required to be made of cast iron.

Fans

WPB reports that members of the Domestic and Commercial Electric Fan Industry Advisory Committee have emphasized that no production of electric fans for retail sale to civilians can be resumed, and production of fans for essential industrial and hospital purposes cannot be increased enough to meet the demand under present restrictions.

Committee members said that the industry cannot be re-opened for civilian production without detriment to the war work in which the industry is engaged.

They recommended, however, that limitations on materials needed by the industry be relaxed sufficiently to permit the carrying out of a war emergency program for the production of 100,000 fans this year to fill military and export orders and as much of the essential industrial and hospital demand as possible.

Materials Lists Simplified

A revision has been announced in the procedure for obtaining authorization to begin construction of apartment buildings, hotels and office and loft buildings. The new procedure eliminates the requirement that the applicant list all materials needed to complete the job. The applicant is still required to justify the essentiality of the project and list certain scarce items of equipment and materials, but he is no longer required to specifically enumerate all construction materials needed.

Applications are to be made on WPB Form 617, which includes a guide, "Construction Limitations," which indicates in advance the current prohibitions and restrictions on the use of critical materials.

Volunteers Sought

To assist the Solid Fuels Administration for War in administering the coal program for next season, efforts are to be made to establish regional and local volunteer organizations to make recommendations based on local conditions. The volunteer organizations will be composed largely of coal dealers, whose functions will include:

1. Foreseeing threatening shortages and arranging with the Solid Fuels Administrator for emergency shipments where needed to avoid occurrence of a shortage.
2. Ascertaining which dealers or consumers are actually in need of preferential deliveries of coal and coke to avoid distress.
3. Maintaining headquarters through which consumers who cannot obtain solid fuels from normal suppliers, and through which new or "orphan" consumers may obtain emergency relief until permanent arrangements can be made to furnish them with fuel.

The committees will also be expected to give their assistance to the spring and summer distribution programs of the Solid Fuels Administration to build consumer and dealer fuel stocks when supplies are available for that purpose. The formal basis for establishment of the new system of advisory and emergency committees was given with the issuance of Solid Fuels Administration for War Order No. 12, after consultation with the industry.

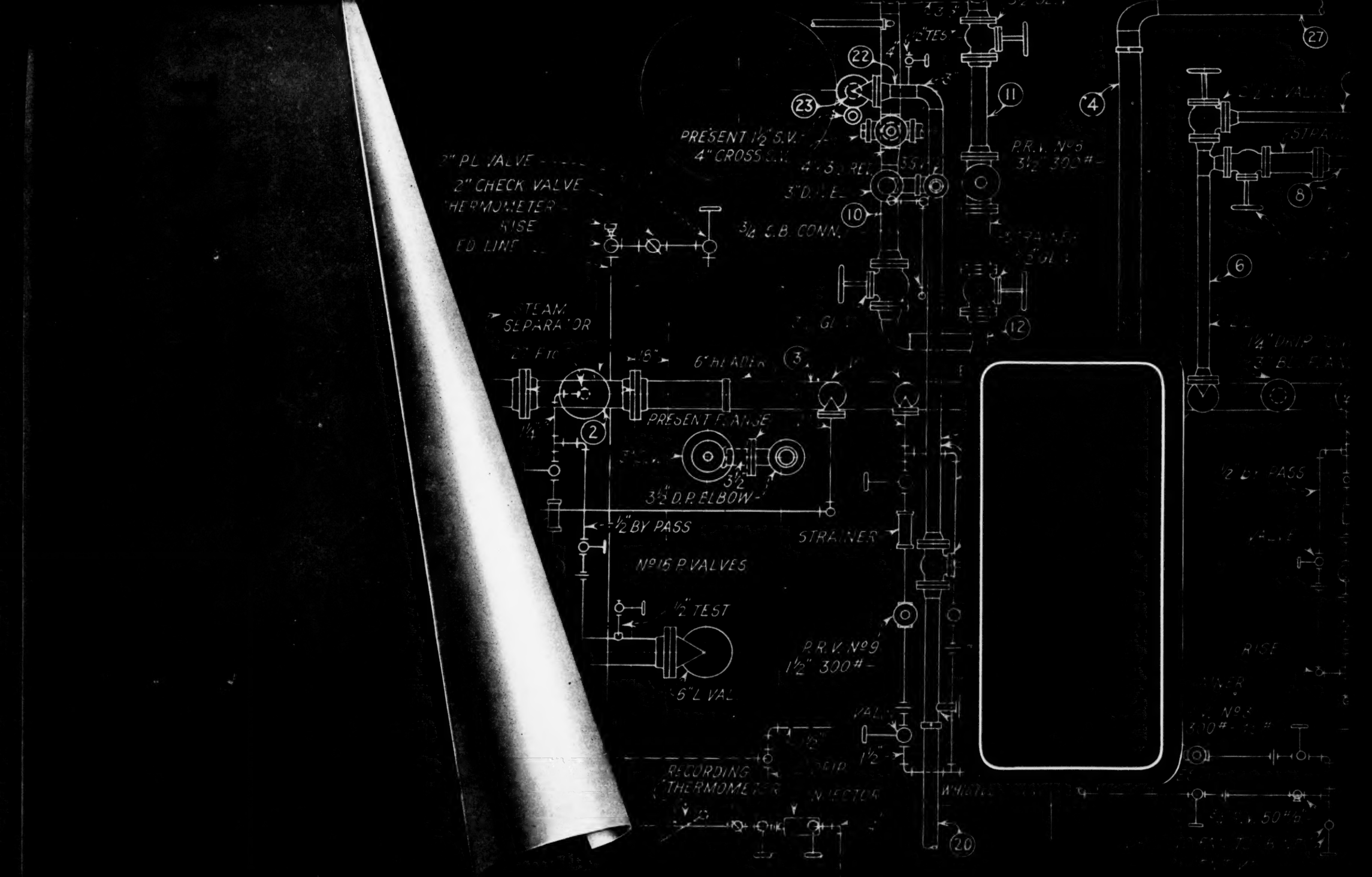
Fuel Rationing Continues

With most folks worrying about this winter's fuel supplies, the Office of Price Adminstration and the Solid Fuels Administrator for War are already concerned about next winter. The Fuel Rationing Division of OPA opened the first of a three-week series of conferences concerning the 1944-45 program on February 23 at Washington. The initial meetings were between OPA representatives and the Division's Industry Council. Later meetings will be held with OPA field representatives, and a final two-day session will again summon industry representatives to Washington in mid-March.

Plans for the reissuance of next year's fuel oil rations to consumers as soon as possible will be the most immediate problem to be worked out at the meetings. It is important that consumers receive their new rations early, OPA pointed out, so that they will be in a better position to stock up on oil during the summer. Results of the three-week conferences will determine what changes, if any, will be made in rationing plans for next season.

Transportation Unified

Crude oil and petroleum product supply and transportation functions within the Petroleum Administration for War have been combined in a single Supply and Transportation Division and all distribution activities to an expanded Distribution and Marketing Division.


PRESENT 1½" S.V.
4" CROSS S.V.
2" PL VALVE
2" CHECK VALVE
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RISE
ED LINE
¾ C.B. CONN.
STEAM
SEPARATOR
6" HEADER
PRESENT FLANGE
3½ D.P. ELBOW
½" BY PASS
STRAINER
№15 P. VALVES
½" TEST
6" L VAL
P.R.V. №9
1½" 300#
RECORDING
THERMOMETER
P.R.V. №5
3½" 300#
STRAINER
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Heating the Post-War House

By ROBERT K. THULMAN
Chief, Mechanical Equipment Section, Technical Division, Federal Housing Administration, Washington, D. C.

TO most of us, it seems, the term "post-war" implies a period beginning at the close of the war and extending up to about ten years after the war's end. Developments in residential heating likely to take place during the first half of that period can be predicted with some accuracy. Developments during the last half are at least possible of conjecture. In forecasting such developments the trends of the pre-war and war periods are of considerable importance.

Pre-War Period

When the history of residential heating through a long-term period is studied, it is apparent that the rate of progress in improvement has been slow. When progress, expressed in any appropriate term, is plotted against time, the resulting graph might be similar to Fig. 1. With scarcely any upward trend until 1920, rate of progress spurted when automatic fuel burners were produced at prices within the reach of a large number of home owners. During this upward trend, however, the main concern was the adaptation of automatically-fired equipment to existing systems. There was little interest in the development of equipment to meet house-heating problems as a proposition requiring serious economic and physiological considerations. It was not until during and after the depression period that interest in the house-heating problem, and especially the peculiarly different aspects of that problem as they applied to the small home, was at all pronounced.

The principal obstacle appeared to be the lack of a clear understanding of what standards of performance were necessary to provide a thermal environment which would be healthful for, and acceptable to, the people who live in houses. The situation was further complicated by the fact that most of the people who live in houses don't know precisely what they should expect and, in a country with such a broad range of climate and such a wide variety of house construction as the United States, no single solution was possible. The result was a variety of heating-equipment ranging all the way from unvented space heaters to complicated systems responsive to sensitive automatic controls, providing all of the desirable thermal conditions engineering skill could produce. Installation and operating costs and standards of performance varied markedly. The only point upon which there appeared to be any reasonable agreement was that the temperature to be maintained in a house should be about 70F.

Under such conditions it is not surprising that the best talent in the heating field chose to direct its efforts toward the study of the control of air conditions and thermal environments in manufacturing where the results could be measured in terms of increased production or an improved lower cost and product. Where new devices were developed for residential heating systems to improve the quality of performance, such as automatic humidifiers or thermostatic controls, they were usually adaptations of devices developed originally for industry.

During the five years from 1927 to 1941, as residential construction more than doubled, headway was made toward a clearer understanding and a more specific definition of good house-heating. Codes and standards relating to performance of individual types of equipment were revised and some new codes and standards introduced. This activity, although slow and complicated, served to stimulate the interest of the heating industry and the heating engineering profession in the development of a final definition of the objective.

Effect of War

Most of this work was suspended during the war period; many of the standards were necessarily (and sometimes unnecessarily) ignored under the pressure of forced production, conversion and material shortages. There was a sharp reduction in the quality of heating devices. Limitation orders narrowly circumscribed the use of these devices. Victory models were largely disappointing, poorly constructed, over-rated and short-lived. The war period threatened a return to the stove era with all its anachronistic concomitants.

Shortages of fuel, particularly of oil and gas, were responsible for a marked increase in the use of coal-burning equipment. But nothing the coal or heating industries had to offer could touch oil or gas equipment for convenience, cleanliness and precision of control. Even drastic oil rationing brought about a rather negligible conversion to coal; the majority of home owners seemed to prefer shivering to shoveling. Use of insulation served to mitigate, to some extent, the effects of poor per-

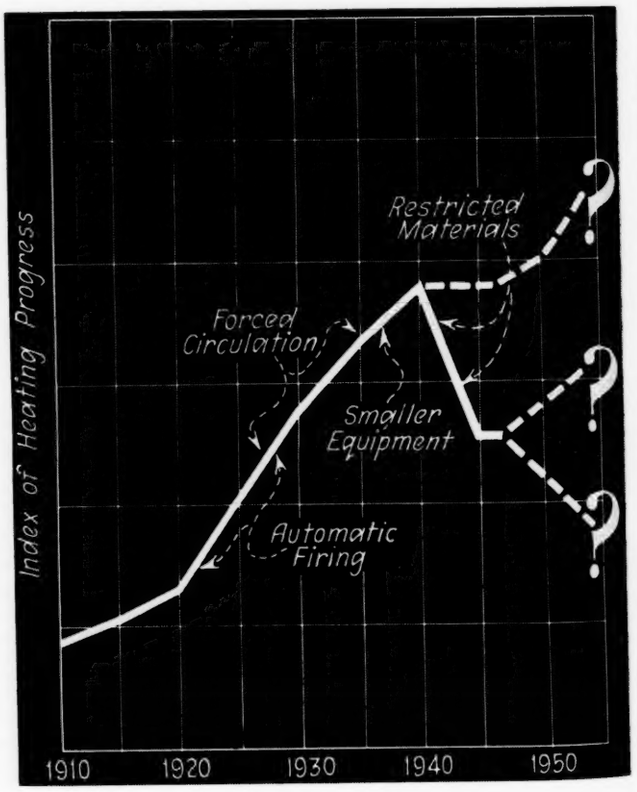


Fig. 1. Trend of heating progress plotted in any suitable scale against time and indicating the three possible courses which might be followed after the war.

EDITOR'S NOTE: The opinions expressed in this article are Mr. Thulman's and are not necessarily those of the Federal Housing Administration.

formance of the heating equipment available for new housing and lessened the suffering due to fuel restrictions for all housing. Lack of motors to drive fans increased the recourse to gravity heating systems and the discoveries, rather disconcerting to the sponsors of forced warm air systems, that houses could be heated quite comfortably by gravity, and that a constant gentle circulation of warm air produced a better result with less trouble *from the service standpoint* than intermittent "hot shots" with a fan. It may be, and in fact it is quite probable, that the gravity hot water system may return to favor for the same reason.

Which direction will the progress curve take after the war? Will it move slowly upward again from its present position ten years behind the times? Will it sag downward under the depressing demand for cheap equipment to do an incompletely defined job? Will it pick up where it left off in 1940 and bound rapidly upward according to the prognostications of some of the more enthusiastic writers? Or will it continue a conservative advance from the point at which the war program sent it into a nose dive?

Post-War Building Types and Trends

To predict the path that the practices and techniques in post-war residential heating will follow it is necessary to consider some fundamental influences which will affect the trends. Important influences are the probable volume of housing construction and the type, design and distribution of the housing market. It is possible that the small house of the future will be prefabricated at strategically located factories from which completed structures of glass and plastics will emerge at regular twenty-minute intervals to be carted away on a truck with a couple of skilled mechanics to put it together on the lot. It is also possible that it may consist of huge glass areas oriented to absorb solar radiation, even the ultraviolet, so that the heating problem will be similar to that of the greenhouse and the cost of heating will be relatively trivial. Supersensitive controls operating with superhuman intelligence on a highly responsive system may maintain comfort conditions of the structure within hairbreadth limits. These things may some day come to pass but it is a far more likely guess that residential building construction for the post-war period will continue to develop along familiar lines and that, instead of a profusion of fantastic incongruous, crystal cartons mushrooming over the country-side there will be an orderly continuation of the construction of little houses of conventional designs with dormer windows, sloping roofs and white picket fences. Prefabrication, functional design, and modern architecture will exert their influences and their better features will endure, but the typical post-war house will, in appearance and construction at least, be not too unlike its pre-war predecessor. It will, however, be different in three important respects which will affect heating.

First, the post-war house will be slightly smaller than the pre-war house. The trend toward smaller houses in terms of number of rooms will continue downward leveling off at about a 5.5 room average as shown in Fig. 2. The reason for this trend is the more efficient utilization of space through better planning so that the same freedom characteristic of the larger house of the early '30's will be possible in 5.5 rooms.

Second, it will be cheaper. The downward trend of average cost for the pre-war period is shown in Fig. 3 and shows no sign of leveling off although it may be expected to tend in a more horizontal direction at about $4,000.

Third, and most important, it will lose less heat.

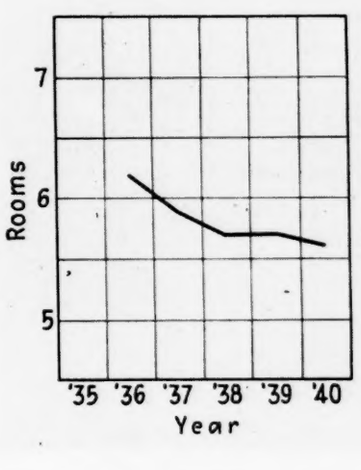
These three differences for the average house have little meaning unless they are tied in with the volume of construction. Fig. 4 shows the volume of privately-financed housing, privately-financed housing with FHA mortgage insurance and public housing for the years 1935 through 1942 with an estimate of the total for the first year after the war. The estimate is based on a recent FHA survey. It is apparent that the bulk of housing construction in normal years is privately financed. It is also apparent that the large expansion of FHA construction can influence private housing quality. Only in 1942 was there a considerable volume of public housing. Fig. 5 is a breakdown of privately-financed housing according to type and shows that the bulk of housing is the single-family detached unit.

Fig. 6 is a similar distribution of FHA construction and shows that in this category also the single-family small house is even more predominant.

Return to normal construction volume after the war will be gradual. The house building industry crosses so many other industry lines that its restoration to normal volume depends on the attainment of normal production in practically all other industries. If past performance can be used as a guide the bulk of post-war housing will be privately financed and will consist principally of single-family units.

It is important to know the distribution of costs as well as the trends of average costs. Fig. 7 shows frequency distribution for two pre-war years and the probable cost-distribution for a typical post-war year of FHA construction. The trend is toward a narrowing of the cost range with the axis of the curve moving progressively toward $4,000. This doesn't necessarily mean that there will be no $10,000 or $15,000 houses built, nor does it mean that there will not be some attempts made to provide extremely low-cost units for $2,000 or even less. It does indicate that the post-war home cost-trend will be similar to the trend followed by the automobile—the range of costs will be narrower and the difference in utility value between the low and high cost models will be less.

Fig. 8 shows two frequency curves of maximum hourly heat loss. The first is for the war year 1942 during



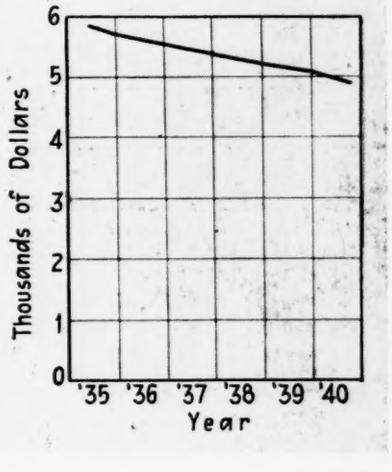


Fig. 2. (Left) Trend toward smaller number of rooms per house as indicated by pre-war statistics. Fig. 3. (Right) Downward trend of average cost of house.

which time insulation was used in greater quantity than ever before, and the second, for a typical post-war year. It is the trend toward a narrowing of the range of heat losses that bears on the design of heating equipment most forcefully.

Insulation and Post-War Housing

Of the three probable differences between the post-war and pre-war house, lower heat loss is by far the most important and it would seem to be self-evident that it is highly desirable. It is not certain, however, that it can be accomplished easily because it is not certain that the insulation industry, upon which we must depend for the greater part of the support of an effective insulation program, can better, during the post-war years, its accomplishments of the pre-war period. During those pre-war years the actual number of insulated houses was disappointingly small.

An analysis of some 12,000 FHA houses constructed during 1940 showed that only about 10% used insulation in both walls and ceilings and only 23% used insulation in ceilings only. The analysis was based on a sample carefully calculated to represent nationwide construction practices and covered new houses built prior to the restricting influences of the war economy.

Most insulation manufacturers have labored under the impression that insulation in new houses was much more widely used than this survey showed. They got this impression quite naturally from their own sales records which showed rapid rises in volume, yet the market for insulation in new houses had actually scarcely been scratched. It was probably natural to expect that, in a competitive industry consisting mainly of two distinct groups with diametrically opposite views about insulation, there should be developed two quite different sales stories. On the one hand was the mineral wool group advocating the filling of stud and joist spaces with light weight materials which add nothing to the structural strength of the building but which effect substantial reductions in heat loss; on the other were the rigid or structural board group offering a material combining some insulation value with sufficient structural rigidity to serve as a substitute for wood sheathing and plaster base.

Under the circumstance it was not surprising that the salesman on the firing line should attack his competitor's product. Some of the sales stories were weird, some were based on facts, but all followed the same general scheme of condemning other insulation materials. Unfortunately, this policy effectively deterred public acceptance of insulation. At one time during the height of a building boom in one eastern locality the salesmen in one sub-division actually featured the absence of insulation in the houses they were selling. In this particular case it had been observed that prospective purchasers were reluctant to buy insulated houses because of the reported dangers of moisture accumulation in walls where mineral wool was used, or infestation by rodents and insects to which certain vegetable fiber insulating materials were supposed to be attractive, or the danger of arsenic poisoning in materials treated with arsenic for commercial reasons and even of lead-poisoning from lead slag wool. These prospective purchasers had concluded that it was better to forego the advantages of insulation rather than to expose themselves and their families to the dangers of deliquescent, rat-nesting or toxic materials.

Most of these stories have disappeared, probably because the facilities of the insulation industry have been so heavily taxed to fill the demand for insulation to relieve the discomforts of fuel shortages that little if any competitive selling is necessary.

Much less virulent but none the less retardant has been the predilection of the insulation interests to the sales story based on the financial return on the investment in insulation. Much time and many dollars have been spent to develop background sales material to support this story. Even the law of diminishing returns has been invoked to prove that any insulation thicker than 25/32 inches is a waste of good money. These discussions reached a high plane and learned technical papers were prepared to show that the proper amount of insulating to use could be readily determined by

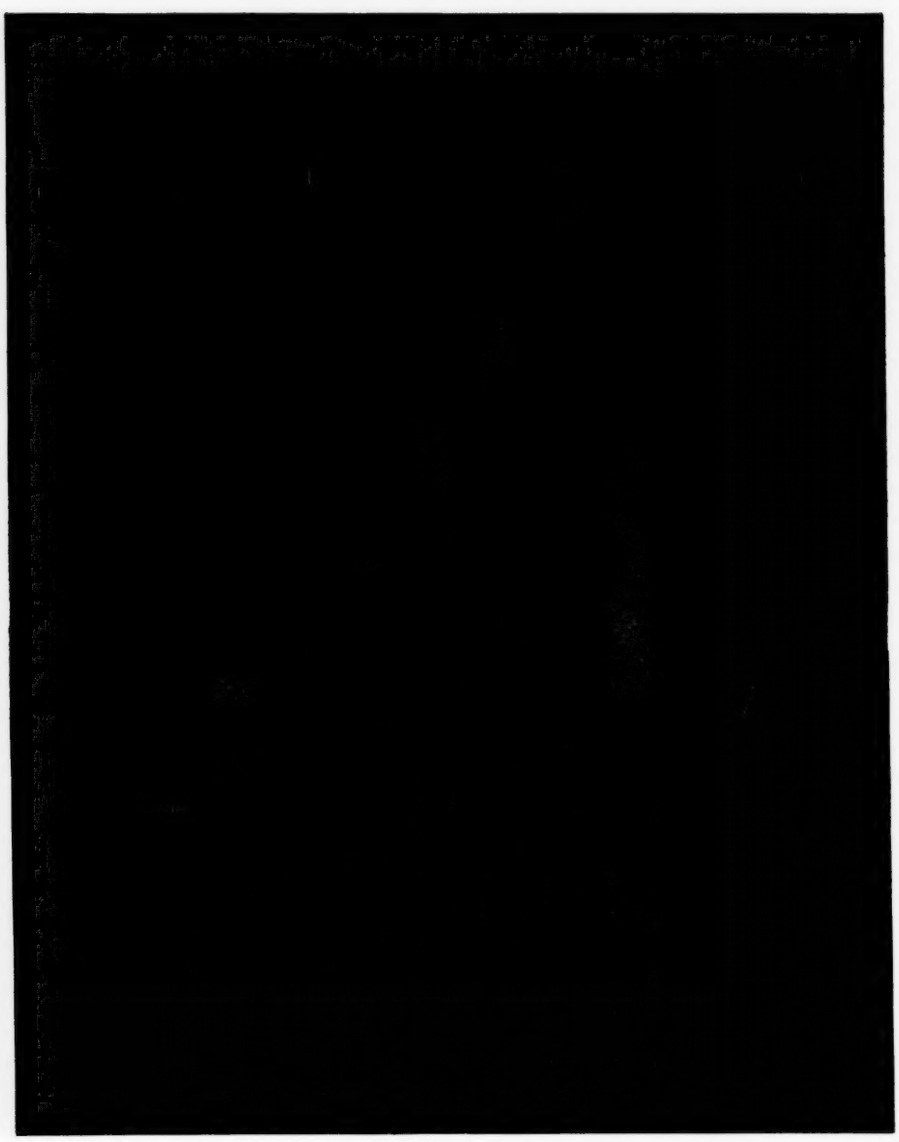


Fig. 4. Volume of privately-financed housing, FHA-insured, private housing and public housing.

various formulae enbracing interest, amortization, fuel costs and degree-days.

Actually, one of the reasons why most people buy homes is because they want shelter from the elements, a place in which they can enjoy health and comfort, and the fact that insulation—any insulation, and the more insulation the better—can contribute substantially toward better health and comfort, was overlooked or ignored. Instead, it was elected to sell the home owner an "investment," on the basis of its return in the form of fuel savings. Unless the entire house were insulated with a single product the salesman was most unhappy in spite of the fact that it is patent that combinations of fill, rigid board blanket, and reflective insulation used in their logical and proper places can do a better job than any single one of them alone, and in spite of the fact that there is plenty of potential market for all types.

It was not until the war economy dictated drastic curtailment of the use of critical metals that the use of insulation in war housing was required. It was recognized that a limit on the weight of metal for a heating plant would tend to eliminate certain heavier equipment and standardize equipment design too narrowly. All kinds of heating equipment were needed to meet the war housing needs, yet economies in metal were essential. The philosophy back of the insulation requirement was the substitution of non-critical insulating materials for critical metals and was based on the theory that a general reduction in the *capacity* of all heating equipment would reduce the total overall weight of that equipment. It was accordingly required that the output capacity in Btu per hour of the heating system for a house should not exceed 66 times the flow area in square feet, and the heat loss of the house should not exceed the capacity of the heating system used. For example, in a house with a floor area of 800 sq ft the heating system capacity could not exceed 800 x 66 or 52,800 Btu per hour. If, in this house, a system with a capacity of 50,000 Btu per hour were used, the construction was required to include enough insulation to reduce the maximum hourly heat loss to 50,000 Btu per hour.

The figure *66* was arrived at arbitrarily and amounted essentially to a compromise to permit the best use of all of the insulation materials available and, at the same time, to effect a reasonable reduction in the size, and consequently the weight, of heating equipment. A rather extensive survey indicated that the heat losses of typical houses were running around 90 Btu per sq ft of floor area; in other words, the 800 sq ft house had a maximum hourly heat loss of about 70,000 Btu. The 66 Btu requirement reduced this heat loss to about 50,000 or a reduction of close to 30% with a weight reduction of the heating system somewhat less, probably about 20%.

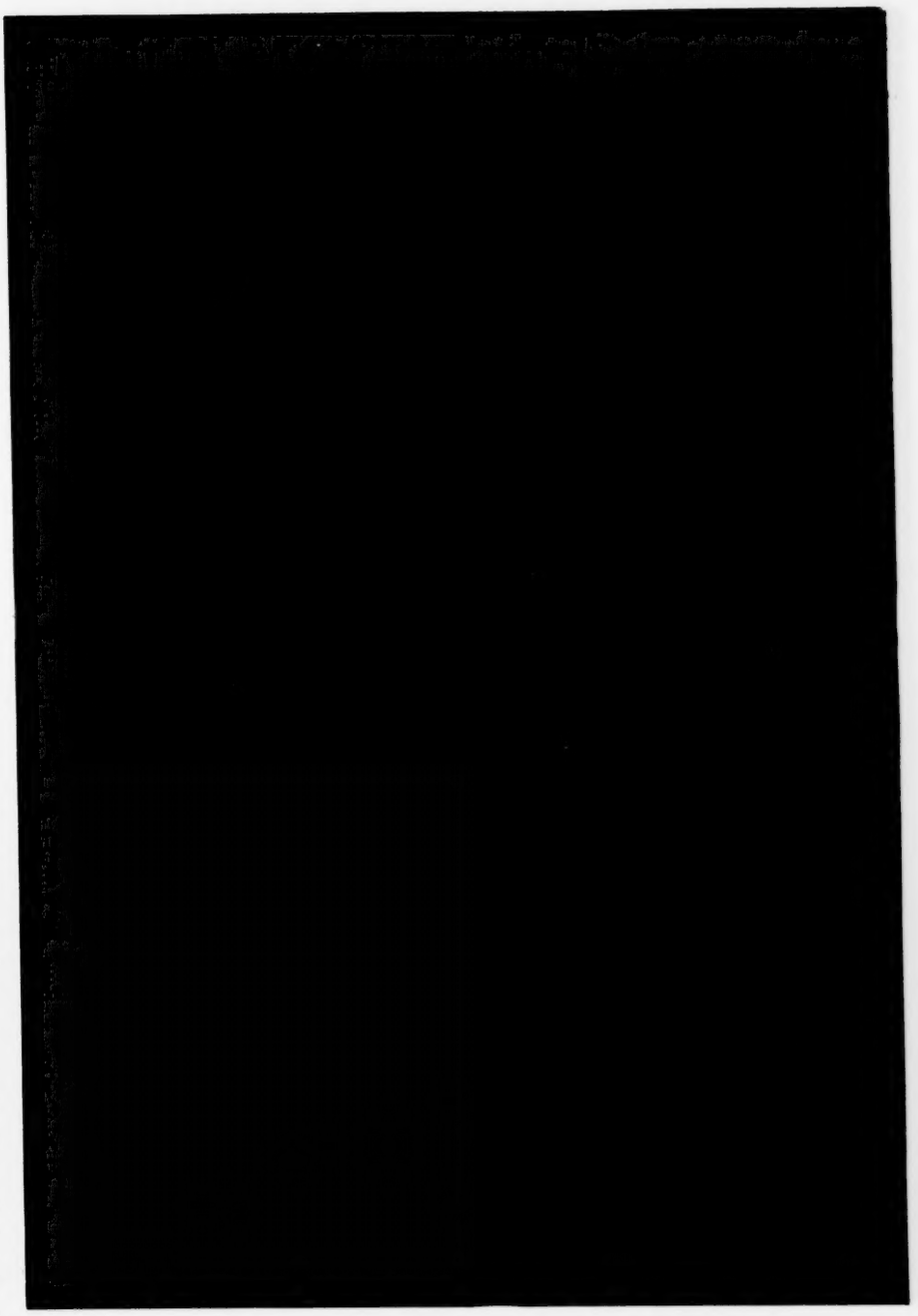


Fig. 5. Breakdown of privately-financed housing according to type, showing predomination of single-family house.

It is to be hoped that in the post-war period, the obvious advantages of advocating combinations of insulating materials each in its proper and most effective place in the structure will be given more attention. For instance, mineral wool and blankets seem to be best suited for ceiling application. Light in weight, they can be applied over the ceiling material itself without adding to the load on the ceiling construction. Rigid board, properly designed to add to the structural strength of the building by increasing present densities and thicknesses, appears to have a logical application in walls. Reflective materials, because of their greater resistance to downward heat flow might best be applied to floors and the underside of sloping roofs and, because of their vapor resistance, in combination with rigid boards, in walls.

Present minimum requirements for natural lighting specify a glass area to floor area ratio of at least 1 to 10. Actually the fenestration in conventional architectural designs provides a ratio of glass area to floor area of 1 to 5. Modern architectural design includes glass areas up to 50% of the floor area, a ratio of 1 to 2. Even

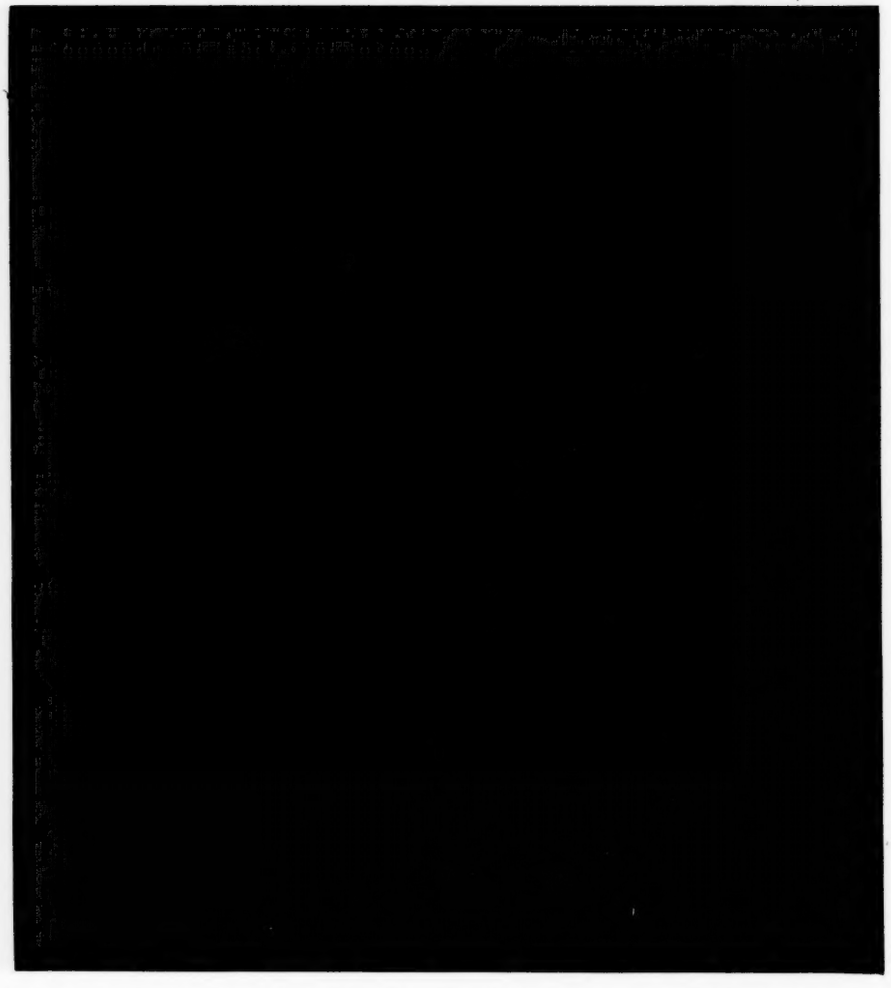


Fig. 6. Breakdown of FHA-insured construction by type showing dominance of single-family small housing. Compare with Fig. 5.

conventional architectural designs are tending toward more generous glass areas. Double glazing and storm windows permit the use of larger glass areas without increasing the heat loss materially and at the same time serve to raise the glass surface temperatures and improve the comfort conditions.

Fig. 9 illustrates a section through the various parts of a house through which heat is lost with insulations combined in a manner calculated most effectively to utilize the advantage of each kind. The heat loss of a house insulated in this manner would be reduced to approximately 0.40 Btu per square foot of floor area per degree design temperature difference as compared with 1.00 Btu characteristic of common only partially insulated construction. The formula on which the fuel oil rationing program was based assumed the latter figure. The requirement of 66 Btu for war housing construction would, in a locality where the design temperature is zero, correspond to 66 divided by 70, or 0.94 Btu and, where the design temperature is —10F, to 0.825 Btu.

It is not altogether safe to assume that heat losses can be reduced to the extent indicated by the above figures. Tighter construction and weather stripping may so reduce the infiltration as to require some forced ventilation to prevent vitiation of the air in the house. Air introduced in this manner would necessarily require heat. But generous use of insulation, logically applied, can materially reduce the cost of home ownership and can simplify the heating problem enormously.

A secondary and highly advantageous result of limited heat losses through insulation is the interesting possibility of standardization of heating equipment sizes. There is no question that the elimination of overlapping sizes can reduce costs, in fact much was accomplished in this direction during the war period when deluxe lines and wide choice of capacities were dropped in favor of the acknowledged economies of production based on a few models.

If there were available only a single heating unit attractively priced it is not unreasonable to suppose that builders might prefer to include enough insulation in their houses to permit the use of such a unit rather than spend more money for a larger and more expensive device capable of handling the less completely insulated structure. Certainly the house owner would benefit economically and physiologically. Lower first cost, lower operating cost and a more healthful thermal environment would result.

In so far as post-war housing is concerned it can be predicted that

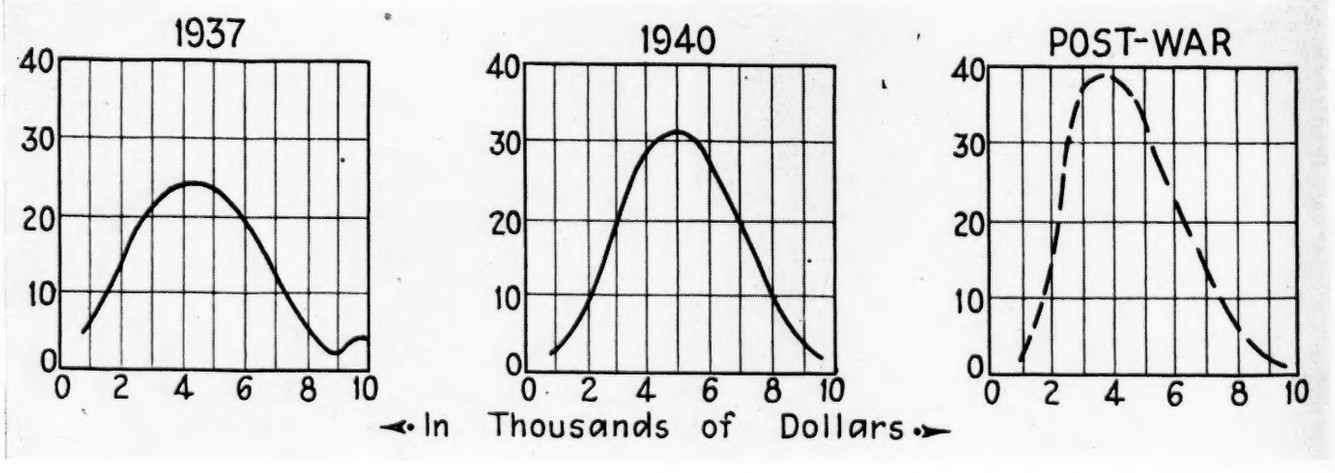


Fig. 7. Frequency distribution of cost of houses for two pre-war years, and an estimate of post-war cost distribution.

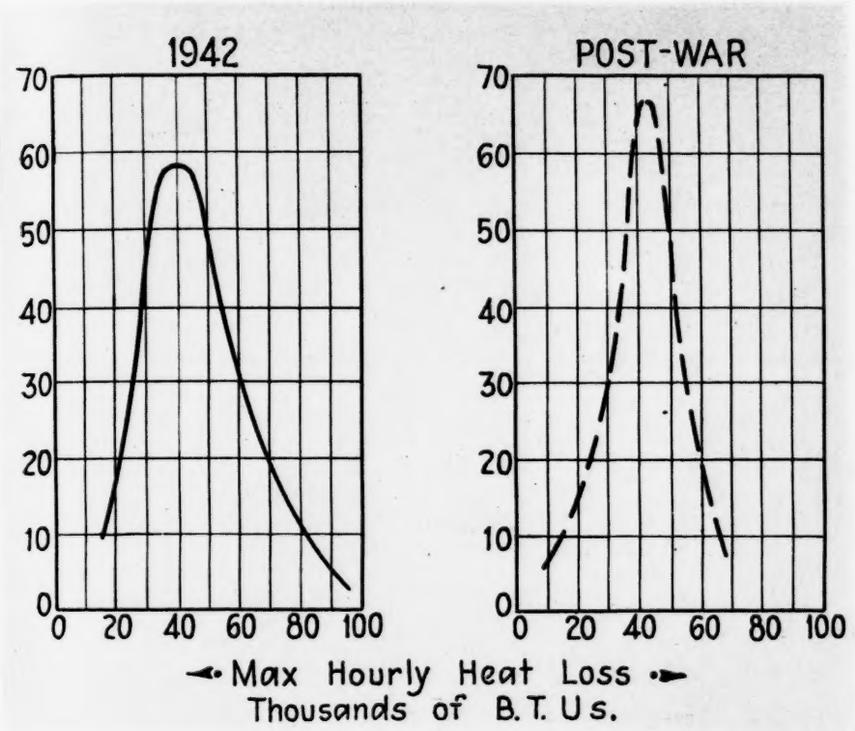


Fig. 8. Frequency curves of maximum hourly heat loss for 1942 and a post-war year showing the narrowing of the range. In other words, not only will the majority have a heat loss in the neighborhood of 40,000 Btu per hr, but the tendency to cluster about this point will be greater than before.

the greatest percentage of it will consist of single family detached dwellings privately constructed and selling for $2000 to $9000 with more than 70% selling for less than $6000. The typical house will have 5 to 6 rooms and will be conventionally designed and constructed. Judicious use of insulation mainly for the purpose of improving the comfort conditions of the house will result in maximum hourly heat losses of less than 60,000 Btu per hour and over 80% will have heat losses of 50,000 Btu or less.

Fuels and Post-War Housing

What about fuels? A consideration of this second fundamental requires an analysis of the country's fuel resources and some study of the past fuel-use experience. For convenience in comparing the relative positions of the different kinds of fuel all of the data given here are in Btu.

Of the total reserves of heat energy, by far the most abundant are in coal. See Table 1.

Of our known reserves in heat energy, 98.8% are in coal and, if production continued at the 1942 rate, there would be enough coal to last 3,830 years. Present known resources of oil, other than in shale, would, at the 1942 rate of production, last only 14 years. A much greater portion of the annual output of coal is used for residential heating than any of the other fuels. Assuming the annual output of wood is approximately equal to the consumption and that all fuel wood is used for residential heating purposes, Table 2 shows the relation of the consumption of fuel for residential heating in relation to the annual production.

Fig. 10, showing the total production of heat energy proportioned among the several fuels, is a graphical presentation of the first column in Table 2.

Oil and gas for heating are utilized generally more efficiently for residential heating than coal and much more efficiently than wood. This is illustrated in Fig. 11 showing a comparison between the heating energy in fuel input as compared with heating plant output for the common fuels. The relative areas of the two circles are proportionate to the respective quantities; within each circle the distribution is shown for all fuels. The difference between the two totals (2,656,000,000,000,000 Btu) represents an estimate of the energy escaping from U. S. residential chimneys. Some of this energy is used for the creation of a draft necessary to make most domestic heating equipment work, but a large part of this loss is preventable. The useful heat (2,382,000,000,000,000 Btu) is dissipated through the walls, ceilings, floors and cracks of 34,000,000 dwelling units; a large part of it can be saved by the use of insulation.

There can be no valid reason for the continued dissipation through the walls, ceilings, floors and cracks of the post-war house of such a large proportion of the input heat energy. The generous use of insulation can prevent a substantial portion. Neither can there be a valid reason for the continued inordinate waste of valuable fuel for the purpose of creating a draft in massive chimneys admittedly functionally inefficient and, judging by the fire-loss records, none too safe. It doesn't appear to

TABLE 1.—AVAILABILITY OF NATURAL FUELS IN THE U. S.

Fuel	Reserves Btu x 10^{12}	1942 Output, Btu x 10^{12}	Ratio, 1942 Output to Reserves
Coal	67,106,828	17,520	1:3830
Oil	118,000	8,400	1:14
Oil Shale	579,000	None	—
Natural Gas	104,500	3,300	1:32
Total	67,908,328	29,220	

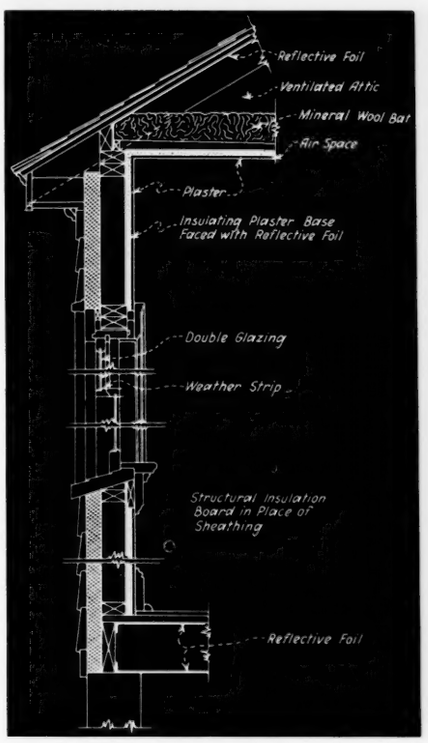


Fig. 9. Section through the various parts of a house through which heat is lost, showing how insulation could be applied in a manner calculated so as to use the advantages of each type of insulation.

Fig. 10. Relative total production of heat energy proportioned among the several fuels.

be too unreasonable to expect in the post-war period that more attention will be given in the design of heating devices to the provision of sufficient heating surface within the device itself to absorb a much greater percentage of the heat energy of the fuel.

The significant facts concerning fuel are, first; the quantity of any fuel actually consumed for residential heating purposes is a very small portion of the total consumption and substantial reductions in even this small amount can be effected through improved utilization and reduced building heat losses. Oil and gas are at present the most convenient, most efficiently utilized and cleanest, and therefore the most logical house heating fuels for individual private dwellings and small apartment buildings. The total drain on the oil and gas resources for residential heating is, under existing circumstances, not at all alarming.

To achieve a competitive position coal-burning equipment must be designed to burn coal cleanly and more conveniently and preferably automatically. Bituminous coal-burning equipment must be designed for smokeless combustion. A promising war-time development is a number of magazine-type coal-burning devices. In some instances these devices, based on principles fundamentally sound, have failed because of impermanent construction necessitated by the exigencies of the war. It is hoped that the availability of a greater variety of materials capable of withstanding higher temperatures and corrosive gases will enable this evolution to continue. Present conventional surface-fired equipment, especially hand-fired devices used with bituminous coal, aren't calculated to impress the post-war homeowner to whom a choice of other fuels is available. It is possible that the experience with wartime devices will hasten the development of coal equipment which has at least some

TABLE 2.—ANNUAL PRODUCTION AND CONSUMPTION OF RESIDENTIAL HEATING FUELS

Fuel	Total Annual Production Btu x 10^{12}	Annual Consumption for Residential Heating Btu x 10^{12}	Annual Consumption, Per Cent of Annual Production
Coal	17,520	2,787	15.9
Oil	8,400	526	6.3
Gas	3,300	271	8.2
Wood	1,454*	1,454	100.0
Total	30,674	5,038	

*Assumed hand-to-mouth, no other heating use.

of the advantages of oil- and gas-fired devices, but it appears that the early post-war house in which coal is burned will probably use the same type of equipment as its pre-war counterpart. On the other hand, oil-burning equipment will be redesigned to handle half gallon rates efficiently but with atomizing devices other than the stationary high pressure nozzle. The experience with aircraft heating will contribute notably toward this end. With gas there is no serious problem involved in lower firing rates.

One of the most important handicaps, however, to more efficient design of heating equipment is the "Standard Ordinance" chimney. Constructed of heavy masonry with high heat loss and too much heat capacity for quick pick-up, its only virtue seems to be its inherent incombustibility. Yet every common coal-, oil-, and gas-burning device depends upon it. To operate properly it is necessary for many of these devices to release flue gases at temperatures over 900F to warm up the chimney within a reasonable time and prevent backdrafts. An attempt to provide a quick-acting draft producer, something beyond a mere vertical tube to allow flue gases to be discharged from the house, is illustrated in Fig. 12. This device was used with considerable success until certain necessary features of it were sacrificed in the interests of economy during the war period. Fortunately steps were taken to correct the faults thus caused and the Underwriters' Laboratories have recently listed a special chimney of this type. Similar devices have been used for many years for gas-fired equipment, particularly on the West Coast.

The illustration shows how other functions can be combined with the venting service. Combustion air is available through a duct communicating directly with the outside and terminating in the chimney cap. Positive provision for combustion air has been found to be necessary because of the tighter construction used during recent years and increased use of weather-stripping pre-

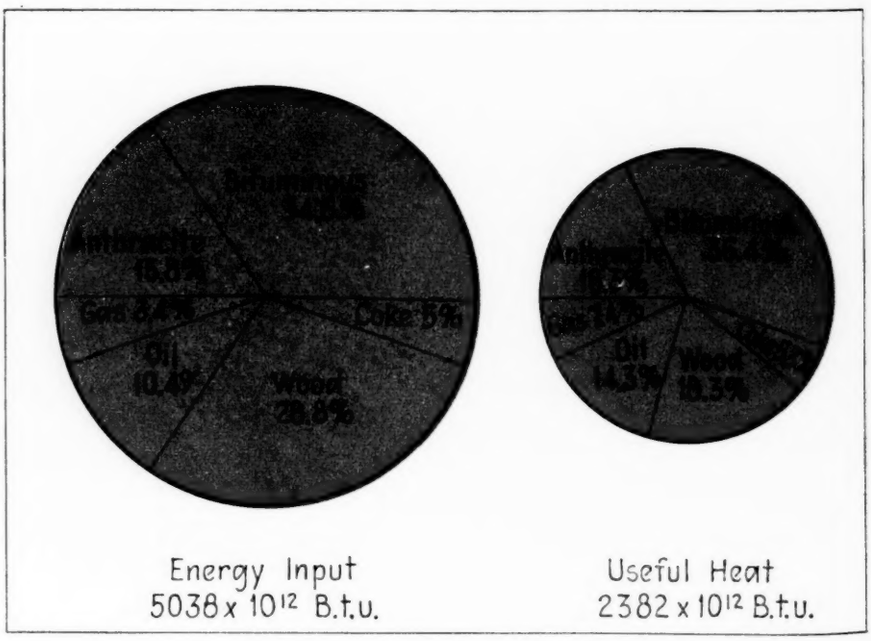


Fig. 11. Residential heating fuels in terms of energy input and useful heat. The areas of the two circles are in proportion to the total energy represented.

venting to a large extent natural infiltration. The chimney cap serves as a discharge for air drawn into the attic through louvers in the gables and serves to ventilate the attic more effectively than louvers alone. More complete attic ventilation can relieve materially the condensation problem involved in ceiling insulation and might improve summer comfort by moving air more rapidly through the attic space.

Panel Heating

There is bound to be a response to the considerable public interest in panel heating and there will be a number of different systems incorporating this principle. Some will be successful but, for the most part, much more experimentation than has yet taken place will be necessary before all the bugs are eliminated. The much lower heat losses of the post-war house will enable panel heating to do a better job than it could with present heat losses. For instance floor panels are limited in output by floor surface temperatures which can be comfortably maintained to produce about 30 Btu per sq ft per hr so that the most effective use of the floor panel seems to be to provide a low basic heat augmented by an auxiliary quick-acting system for quick pickup and extremes of temperature. The generally high heat capacity of the floor construction makes the floor panel system sluggish and complicates the control problem. Ceiling and wall panels are apt to be too expensive and response to requirements is also apt to be too slow for dependence upon them as the sole source of heat. In spite of its limitations, panel heating advantages are sufficient to indicate that some post-war houses will be heated with some arrangement based on this principle.

Service Water Heating

There is one item of household equipment which is independent of climate, heat loss and, to a large extent, of house size or cost—the domestic hot water heater. For the average family, whether it lives in Maine, Florida, Wyoming or Texas, the hot water requirements are fairly constant, and the device to supply those requirements must have a certain minimum capacity and needs no more than an equally easily determined maximum capacity. The capacity might readily be set at 50,000 Btu per hr output without adverse effect on the efficiency, and the idea of using the water heater as the basic heating-unit in the post-war house is both attractive and practical. Systems of this kind have been in use for several years and it is, of course, common practice to attach domestic hot water heating devices to automatically fired boilers for year round use. If the required space heating capacity can be reduced to 50,000 Btu per hr there appears to be no logical reason why the space heating system cannot be successfully attached to the domestic hot water heater.

The heater itself would naturally be designed for more efficient operation than present models and could be attached to almost any type of heat distribution system. A warm air system circulating air through a heat exchanger by either gravity or fan, a panel system using water heated directly or indirectly, or air, heated by a heat exchanger, a radiator or convector system, or a combination of systems can be used. Some of the stand-by losses of the hot water service would be absorbed by the space heating service (and vice-versa) to effect a combined economy for both.

Conclusion

It should not be expected that devices of the sort mentioned in the foregoing will appear in any startling volume immediately after the war. Heating equipment for small houses will be no more revolutionary in design and appearance than will refrigerators, lighting fixtures and systems or plumbing equipment. The first months and perhaps the first year or two will witness a mad scramble of each manufacturer of heating equipment to get into production as rapidly as possible to capture as much of the business as he can. Most will attempt to do this by continuing the production of 1941 models until new designs can be tried out and factories tooled up for new models. There will, therefore, be a large supply of traditional designs installed in the familiar ways.

During the first five years of the post-war period there will most likely be a gradual increase in production of housing consisting largely of compact well-designed little homes built mostly by carpenters and masons. They will be heated in a variety of ways with smaller equipment operating more efficiently and economically. Heating costs will be radically reduced by insulation and double glazing. These small homes will be more comfortable and temperature control will be more accurate and uniform. There will be tried out during this period many novel methods and systems which will attract much attention. Some will be successful, some not. The successful innovations will influence strongly the type of systems used during the second five years.

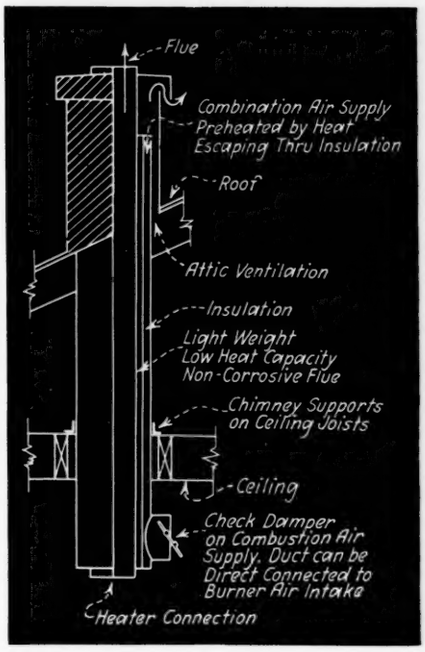

Flue
Combination Air Supply Preheated by Heat Escaping Thru Insulation
Roof
Attic Ventilation
Insulation
Light Weight Low Heat Capacity Non-Corrosive Flue
Chimney Supports on Ceiling Joists
Ceiling
Check Damper on Combustion Air Supply. Duct can be Direct Connected to Burner Air Intake
Heater Connection

Fig. 12. An attempt to provide a quick-acting draft producer believed to have a number of advantages over the conventional chimney.

During the second half of the post-war period we might expect to see a much greater departure from the conventional methods of heating as well as building. As the performance of the new devices used during the first half of the period is demonstrated to be successful the change will be accelerated.

A public appreciation of the benefits of better heating to health and pocketbook — an appreciation wakened by a heating industry finally aware that its ultimate justification for existence is the provision of a much-needed public service; a steadily rising volume of well-built, soundly financed new homes constructed by a coordinated and cooperative home-building industry utilizing fully and intelligently the new materials and techniques developed so rapidly during the war—to meet a steady demand for the security that home ownership alone can foster—may well be the nucleus, the substantial foundation for a sound post-war prosperity.

Health Effects of Ions and of Ozone in Comfort Air Conditioning

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MARK TWAIN'S threadbare adage about the weather implies an objective attitude which ignores the importance of those subjective impressions, described by British investigators as "freshness" and "fragrance," about which modern ventilating engineers know little and are unable to do much. But it is precisely with respect to questions which do not permit of a conclusive answer that conversation is interesting. The antithesis of Twain's viewpoint is expressed by the irate father, in Marcel Proust's masterpiece, who unsuccessfully attempts to engage a guest in discussion of the "freshness" of the atmosphere and subsequently passes judgment in the words, "My poor boy, your friend is out of his mind. Why, he couldn't even tell me what the weather was like. As if there could be anything more interesting!"

Chaucer arranges for one of his entertaining pilgrims to use a moistened leaf placed under his hat "for to keep his head from heat." Samuel Johnson, in the philosophical novel "Rasselas" provides special weather facilities for occupants of the happy valley; these include freshening of the air by artificial showers and relief from the monotony of uniform air movement by use of hydraulic fans. Our own Benjamin Franklin in "The Art of Procuring Pleasant Dreams" suggests that the avoidance of Freudian nightmares is more a matter of open windows than it is a relief from inhibitions. Edwin Cerio attributes the vagaries of life on a Mediterranean island to "That Capri Air," while Norman Douglas, in "South Wind," implies a relationship between classical moderation and the sirocco.

What, then, is this vitalizing property of outdoor air about which literary men talk so much, while engineers do so little? Unfortunately we do not know. In spite of all that has so far been done to improve atmospheric conditions in an occupied space there is still lacking that subjective impression of freshness in relation to the environment which is so characteristic of the outdoors. Two small clues, however, have received considerable attention. The first, ionization, seemed for a while to offer the possibility of a positive approach to the problem of creating in spaces served by mechanical air conditioning systems a feeling of freshness. The second, introduction of ozone into ventilation air has been advocated as a means of masking the odors which destroy the psychological feeling of "freshness."

Ionization

Ions are positive or negative electrically charged molecules. They are always present in air and they may be roughly classified as follows: 1. Small ions are clusters of molecules surrounding a charged center and are held in position by electrical force; they may be either positive or negative. 2. Large ions consist of small ion clusters surrounding condensation nuclei. In nature ions are produced by cosmic rays, by solar radiation and by radioactive elements in the soil. Their production artificially can be accomplished by electrical means; equipment for this purpose is commercially available.

Investigations of the small ion content of the atmosphere have shown that the degree of ionization is higher in summer than in winter, on clear days than on rainy or foggy days, in daytime than at night; diurnal variation is from peaks at noon and midnight to lows between 6 and 10 p.m. and between 4 and 8 a.m.; changes in temperature or humidity are usually accompanied by changes in ion content.

Indoors, in unoccupied rooms, the small ion content in winter is less than that outdoors; in summer it is greater. When rooms are occupied the small ion content immediately drops so low that 160 cubic feet of outside air per minute per occupant would be required to maintain a concentration equal to that of outdoor air. When the occupants leave there is an immediate rise in the ion content.

An explanation of most of the above described phenomena seems to be that the small ion content is an inverse function of the large ion content. Wait has shown that the number of condensation nuclei in any room bears a reciprocal relationship to the number of small ions and that the observed reduction in the number of small ions in occupied rooms can be quantitatively accounted for by the increase in condensation nuclei. Recent investigations in Ireland have shown that atmospheric condensation nuclei progressively increase in size with time and that in heavily nucleated air the observed decrease in small ion concentration is the result of growth of nuclei.

These findings suggest a possible explanation of the present widely different ideas regarding ionization. Yaglou, for example, has found no evidence of ions in the expired breath and is inclined to the view that the "stuffiness" that is sometimes noted in

indoor air is due to the reduction of small ions which accompanies occupancy—artificial ionization is thought of as a remedy. Wait, however, claims that there are 200,000,000 ions in every exhalation and that the profusion of ions in occupied spaces leads to "stuffiness"—he recommends deionization by electrical precipitation. Possibly these seemingly contradictory views may both be approximations to the truth. If the exhaled ions to which Wait refers are of the large type then the reciprocal relationship which has been established between large and small ions would furnish an adequate explantion of the decreased small ion concentration which is observed in occupied rooms. The question then arises as to whether the decrease of small ions or the increase of large ions is responsible for the "stuffy" feeling. Until this has been determined there would seem to be no more justification for urging artificial ionization than for urging artificial deionization—in fact the possibility exists that a selective combination of both of these proposals would lead to best results.

In any event there is now a reasonable explanation of many of the ionization phenomena which, for a time, seemed to be directly contradictory. The small ion and large ion investigators are now on common ground and the progress of future research should therefore be more rapid and certain than has, in the past, been possible.

Physiologically, the effects of ionization seem to be responsible for changes in gas diffusion in the lung cells, either colloido-chemically or electrostatically, which in turn produce changes in the blood and finally in the tissues where the reaction is found.

The biological importance of normal atmospheric variations in ion concentration is questionable. Brandt has reported on observations of the effect of such changes on 5 subjects over a one year period; his work failed to disclose any significant physiological effects. On the other hand Chase and Willey placed inbred cultures of "Drosphils melanogaster" in ionized air and noted a resultant discoloration and death of the larvae, thus indicating that ionized air is capable of producing an effect on living material. Bierman expresses the belief that atmospheric ionization may be of medical importance and gives the results of a study of the therapeutic use of polarized air treatments given to 84 cases; the possibilities of such treatments for use with asthma, vasomotor rhinitis, sinusitis and essential hypertension are discussed.

Large ions seem to be of less importance physiologically than small ones. Harrington reports that exposures of 30 minutes to large ion concentrations of 5 to 6 million per cubic centimeter have no effect on metabolism, blood circulation, respiration or subject sensation in healthy male subjects; this is true regardless of the sign of the ions used. Small ions, however, do have physiological effects and these differ with the sign. The respiration of small positive ions causes an increase in oxygen consumption and in metabolic rate and seems to be responsible for headaches; in some cases an irritation of the nose and throat is noted. Kintner observes that a preponderance of such ions "slows up mental activities to such an extent that well educated persons are unable to add columns of figures." Small negative ions, on the other hand, predispose to relaxation, increase mental activity and produce other sensations of a desirable character. A possible disadvantage of small positive ions is noted by Edstrom whose work has shown that their effect on some persons is to cause a decrease in the muscle chronaxia; he suggests that the cause of rheumatic pains which some persons experience in stormy weather may be the hypertension occasioned by the strongly negative ionic state of the atmosphere.

Aside from any value which may eventually accrue through the deliberate control of ionization by artificial methods, the importance of this subject to present day air conditioning derives from the fact that the equipment now in use for conditioning is in itself a factor in the determination of the ionic state of the conditioned space.

Loeb has stated that the electrical charge associated with ions is so small that ionization cannot be responsible for the physiological effects which have been attributed to it; he suggests that engineers would do well to drop the subject. The fact that ions in themselves are unable to cause physiological changes is, however, no reason for questioning the changes which many investigators have observed in connection with ionized air. If Loeb's conclusions are accepted and ions are regarded as inert in their action on humans, the fact remains that there is a substantial body of literature which shows that some property of which the ion concentration seems to be an index, is important physiologically. The property responsible for the effects which have been observed may not be ions, but it is difficult to see why this possibility should deter the engineer from using ions as an index for the measurement, discussion, and control of the unknown factor that is actually responsible.

If it were possible to accomplish the other objectives of air conditioning without affecting ions, the engineer would be willing to ignore this variable until its importance has been more firmly established. Investigators have shown, however, that the passage of air through ventilating ducts, dehumidifiers and like equipment is responsible for material changes in the ionic content of the treated space. Thus, although the engineer may not want to concern himself with ionization, the fact remains that in the work now being done ionization does play a part. In consequence he must determine what the effect of such changes may be and, if they are harmful to health, do something to correct them.

Ozone

The introduction of ozone into ventilating air has been suggested at various times as a means of preventing loss of "freshness," controlling odor, or re-

ducing the danger of infection by deactivating bacteria present in the enclosure. Ozone is frequently used as a means of controlling odor transference in cold storage compartments, but its use in comfort air conditioning must be evaluated in different terms. Unfortunately, most available evidence indicates that ozone in concentration adequate to be of germicidal value is likely to be harmful to occupants.

Elford and Van Den Ende report that a concentration of .04 ppm successfully inactivates unprotected bacteria present in room air of 60-90% relative humidity, but is ineffective for protected bacteria such as are discharged during a sneeze or cough. They report that inactivation of such protected bacteria can only be attained by using decidedly higher concentrations which, for long exposure, would probably endanger the occupants; their conclusion is that ozone cannot be safely used as protection against air-borne bacterial infection.

Yaglou has found that an ozone concentration of .015 ppm can hardly be smelled, but effectively reduced the smell of body odor to a point such that outside air requirements can be reduced by 50%. Higher concentrations were found to be irritating and lower concentrations ineffective. Until methods of control are improved so that ozonators can be effectively actuated by changes in ozone concentration in the enclosed space, it is concluded that ozone should not be used in comfort air conditioning installations.

Bedford, reviewing industrial ventilation problems in war time England indicates (February, 1943) that little reliance can be placed on ozone when used as a deodorant. Crowder, in a paper presented at the 1940 annual meeting of the medical and surgery section of the American Association of Railroads concludes that the known physiological effects of ozone are preponderantly harmful and that concentrations as small as 1 part ozone in 10 million parts of air may be definitely injurious to respiratory membranes; he concludes that ozone has no proper place in ventilation or air conditioning of occupied spaces.

With respect to the use of ozone as a germicide, Coblentz (December, 1942) questions its justification and states that, unless carefully used, it may be responsible for serious injury to the occupants.

Summary

There is some quality of outside air which, for lack of a more precise and evaluable term, can be called "freshness." The factor or factors responsible for this quality have not yet been isolated. Freshness apparently is lost or decreased as air passes through mechanical conditioning equipment; a consequent subjective feeling of "stuffiness" sometimes occurs in an air conditioned space even though known comfort factors are controlled at or near their optimum values.

The ion content of air varies with many factors and there is some reason for believing that ionization may either be partly responsible for, or in some indirect way related to, the feeling of freshness. Lacking additional data the air conditioning engineer should probably not attempt either to ionize or deionize air being supplied to an occupied space. However, present air conditioning methods do affect the ion content and future work on the relationship of ionization to health will therefore be of great interest to the engineer.

The consensus of present opinion seems to be that ozone cannot safely be used as a disinfectant in occupied spaces and should not be used as a deodorant, lacking more precise control methods, in such spaces. The value of ozone for odor control is subject to the additional disadvantage that it merely masks rather than eradicates the odor; one investigator reports that ozone accomplishes its purpose by paralyzing the sense of smell.

Russians Gasify Coal Underground

Underground gasification of coal has been tested in at least two Russian collieries, according to two British publications. First suggested by the Russian chemist Mendeleeff in 1888, the proposal would eliminate most of the labor of mining. The Russians started active experimentation in 1917, but news of the results has been fragmentary.

Two methods of gasification have been employed, the first, or "stream" method, being particularly applicable to sharply inclined seams. Two shafts are sunk, 750 feet apart, and of unspecified depth. A gallery connects them. A fire is ignited. Air is pumped down one; gas is taken from the other.

In one experimental station in the Donbas, gas was produced without interruption for 18 months. This gas varied widely in chemical composition and calorific value owing to experiments involving enrichment of the "blow" with oxygen, the making of "producer" or "water" gas, pressure of air, and length of cycles. Most of the output ranged from 85 to 220 Btu per cubic foot.

The second, or "warehouse", method involves preliminary underground mining, in which chambers in the coal bed are filled with crushed coal.

A third method, the "regenerative", has merely been poposed, and is a variation of the "stream" method, alternate oxygen and steam, or air and steam blows being employed.

The publications report tests in which wells were sunk to thin horizontal seams. This method is designed to eliminate all underground work. Air and steam are pumped down one well, letting the combustion products percolate through cracks and crevices to the other.

Gas of this low thermal value is, obviously unsuited for long-distance transmission, under American conditions, but might conceivably be employed at mine-mouth chemical or power plants.

To determine the relative warmth of fabrics, textiles are wrapped around a drum containing oil, and this oil is heated to body temperature. The current required to maintain the body temperature of the oil varies with different fabrics. This is one of the two cold rooms of the Philadelphia Quartermaster Depot.

Refrigeration Insures Quality of Clothing for the Army

A. J. MALLINCKRODT

TO supply suitable clothing for an army of 8,000,000 men represents a volume of business that justifies extreme care in specifications and inspection of materials. Tests insure the quality.

Clothing must be provided suitable for military activities in the arctic, for high altitude flying, and for jungles in the Southwest Pacific and desert regions. In the construction of the new laboratory at the Philadelphia Quartermaster Depot, it was decided to provide equipment and space to duplicate or exceed all extremes of temperature and humidity that might be encountered by the army in the field.

Textiles are tested routinely for various characteristics, including strength and weight. To avoid corrections of results obtained under existing atmospheric conditions, testing under standardized atmospheric conditions is necessary. For such tests a conditioning room to provide the standard conditions of 70 to 80F is provided. Two smaller cold rooms are also provided.

The conditioning room provides the necessary controlled uniform testing conditions of 65% R.H., 70F which have been standardized by the textile industry to avoid wide variations in test results. To illustrate the necessity, a cotton fabric which, with a moisture content of ½%, broke at 150 lb when conditioned to a normal moisture content under standard conditions, would break at approximately 185 lb. The air conditioning equipment for this room consists of a 15 hp Freon 12 condensing unit, air washer with direct expansion cooling coils, heating coils, surface water heater, and face and by-pass dampers. Control is provided through recording wet and dry bulb controllers, air operated, of the full scale modulating type with automatic droop correction. With this feature, conditions are held at the control point regardless of the load imposed within the capacity range of the equipment.

The wet bulb controller operates the face and by-pass dampers so that when either the humidifying load or dehumidifying load is at a maximum, the face damper is wide open and by-pass damper closed. With a decrease in demand for either of these functions, part of the air is by-passed. As the demand for refrigeration decreases, the wet bulb controller operates to open a modulating by-pass valve between the compressor discharge and suction. When this valve is wide open, there would be a tendency for the compressor to heat excessively. To guard against this condition, when the by-pass valve is approximately half-way open, a solenoid valve is opened to admit a small quantity of liquid Freon through a thermal expansion valve, directly into the suction line of the compressor. The super heat on the compressor suction is maintained at a uniform condition regardless of the position of the compressor by-pass valve. This provides completely modulated control of the refrigeration capacity.

Workers in the cold rooms must be carefully clothed for temperatures can be reduced to —68F. Cold rooms are equipped with a duplicate set of doors. One door weighs over 1,500 pounds.

On low wet bulb temperatures, humidification is provided by the wet bulb controller operating a modulating steam valve to the surface water heater. Low dry bulb temperatures will cause the dry bulb controller to open a modulating steam valve to the reheat coils.

The value of providing full modulating control for refrigeration as well as the heat and damper functions is readily apparent from the close regulation indicated on the wet and dry bulb chart for this room.

For this room, in which a number of people work, a constant quantity of outside air is provided for ventilation. The outside air, as well as the return air, is passed through throw-away type filters.

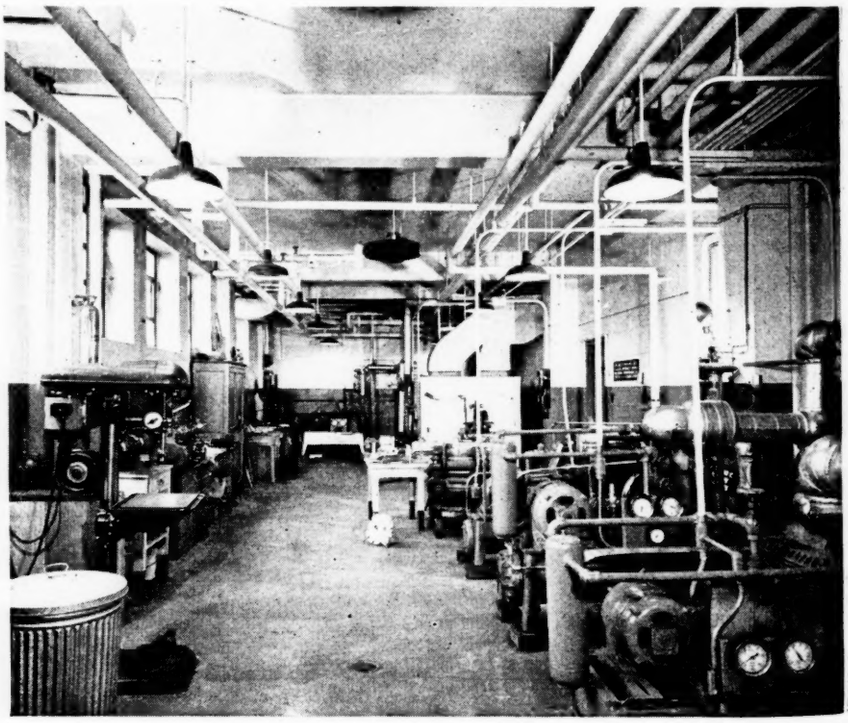
The medium-cold room is used for making tests at various temperature and humidity conditions ranging from 38F to 110F and with 40 per cent to 90 per cent relative humidities.

Four inches of insulation corkboard were so installed as to prevent the admission of moisture to the insulation, either from the inside or from the outside surfaces. Moisture proofing both surfaces is necessary, for at times the vapor pressure in the room will be higher than outside, and at other times lower. Moisture migration from either side, therefore, had to be prevented to retain the insulation value.

Equipment for this room consists of a 3 hp Freon condensing unit and a dry coil conditioning unit incorporating direct expansion cooling coils, heating coils, and volume damper. The heating coil is of the non-freeze type, incorporating steam distributing tubes inside the coil tubes proper. This was considered essential since the temperature of air leaving the cooling coil will at times be considerably below freezing. A pan-type humidifier with steam coil was installed. A pan-type humidifier is relatively inefficient in operation, for when cooling is required, the heat of vaporization of the moisture represents an additional cooling load instead of being deductible from the sensible cooling load, as would be the case with a spray humidifier. The reason for selecting the pan-type humidifier in this case is the ease with which it may be controlled.

Controls consist of wet and dry bulb recording controllers with full throttling range and automatic droop correction. The dry bulb controller operates the volume damper to close it to a minimum position when the dry bulb is at its control point or below. At dry bulb temperatures below the control point, the dry bulb controller opens a modulating steam valve to the reheat coil. The wet bulb controller governs the quantity of refrigeration supplied by means of a compressor suction as described for the conditioning room.

The equipment is so proportioned that when the volume damper is wide open, practically no dehumidification takes place except at very high hu-



Room containing the Baker compressor equipment for the cold chambers.

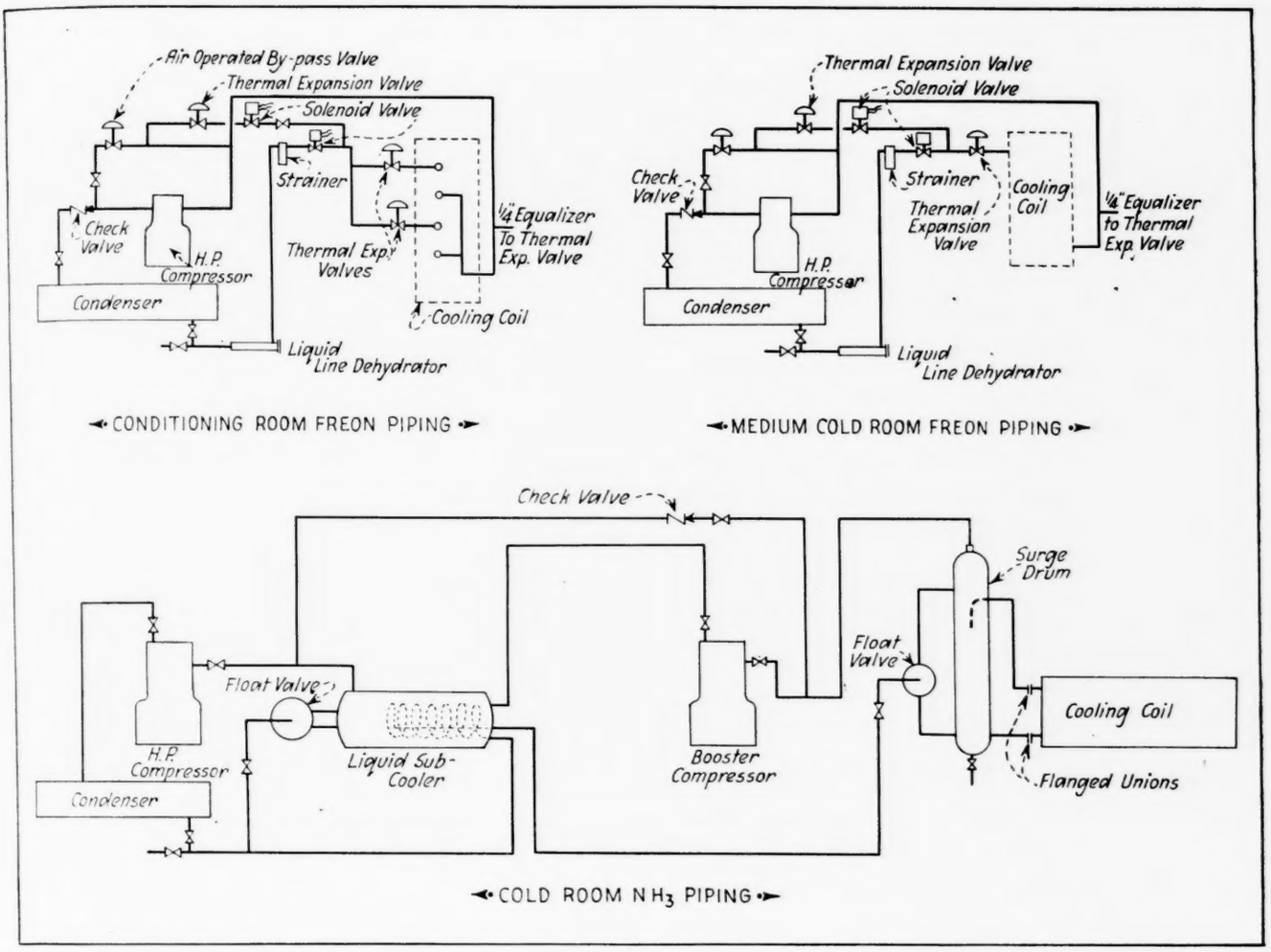


Diagram of the refrigerating piping in the three test rooms.

midity conditions. Under such conditions the dry bulb temperature tends to rise above the control point. When this occurs, the dry bulb controller takes over refrigeration control from the wet bulb controller by means of pneumatic relays. At wet bulb temperatures below the control point, the wet bulb controller opens a modulating steam valve to the steam coil in the pan humidifier. For wet bulb temperatures below freezing, provision is made to switch the control to a hair element humidistat.

Since, at some conditions, continuous operation of the room is required at dew points below freezing, provision is made, by shortening the throttling range of the control instrument, to operate the refrigerating equipment on an on-and-off cycle. When the room is operated at dew points above freezing, the throttling range of the instrument may be increased.

Conditions can be maintained in the cold room from —60F to +70F without regard to relative humidity. Insulation of this room consists of one foot of corkboard. Since the vapor pressure in this room will always be below the vapor pressure on the outside, particular attention to moisture proofing was paid only to the outside surface. The inside surface was treated with a coat of mastic finish scored in small squares. It was understood that when operating at low temperatures, the finish would crack in the score marks. At these low temperatures the finish, of course, loses its plasticity and the shrinkage will necessarily produce cracks. By providing score marks, the appearance of the interior finish is preserved. If this room were also to be used for high humidity tests, use of a metal lining inside the room should be considered.

Most tests to be performed in this room are of quite a long duration and, therefore, it is not essential to provide rapid reduction in temperature. The relatively high thermal capacity of corkboard per unit of insulating value is not detrimental. In rooms where a rapid reduction in temperature is essential, the thermal capacity of the insulation may be the deciding factor in its selection.

The cold room is built in the basement. If the room were operated at low temperatures for a considerable period of time, the ground under the floor would be frozen, causing the floor to crack. In order to prevent this condition, a floor of hollow tile was laid over the concrete sub-floor, so that the openings in the tile provided air passages for ventilation provided by means of a small blower. This enables the sub-floor surface to be maintained approximately at room conditions and freezing of the earth under the

sub-floor is effectively prevented by this procedure.

Refrigerating equipment for this room consists of a simple compound ammonia system using a 5 hp low pressure compressor and a 7½ hp high pressure compressor. Each compressor is provided with an oil separator. The cooling unit consists of a flooded fin coil installed in a casing (sheet metal) within the room. The overhung, single inlet type fan is installed outside of the room so that its bearings are not subjected to the extreme low temperatures, and lubrication difficulties are thereby avoided. A shell and coil liquid subcooler reduces the high pressure liquid temperature to about the saturation temperature corresponding to the intermediate pressure, before the liquid is carried to the float valve on the evaporator. The liquid feed to the shell of this liquid subcooler is also controlled by means of a float valve.

At conditions under which this system operates, only a slight amount of heat could be extracted by an inter cooler of either the air or water cooled type between the two stages of compression. Therefore, this piece of equipment was omitted. However, to prevent excessive discharge temperatures, the discharge from the low pressure compressor is conducted through the vapor space of the liquid subcooler. The control for this room consists of an electrical on-and-off recorder controller.

The air conditioning equipment was designed and installed by Edward H. Reuss, Jr., Inc., Philadelphia, Pa., distributors for Baker Ice Machine Company.

District Heating in Russia

In Russia, district heating has been adopted on a much larger scale than anywhere in Europe. From the beginning, the plans adopted envisaged by-product power generation at a great scale and in accordance with an extensive plan.

The first plan was conceived as early as 1920; it provided for combined heat and power stations in most larger towns, in addition to plants of the strictly industrial type. In 1924 an old power station in Leningrad which has been intended to be scrapped was converted successfully into a district heating station, but more urgent needs in other directions postponed the carrying out of the first five-year plan (1928-32) whose recommendations were based on the results of that first trial station. In the first years of this plan the development concentrated not on municipal or other forms of public utilities, but mostly on industrial heating stations designed for supplying certain industries with their heat and power requirements. They undertook in their stride, so to speak, also to supply the heat requirements of the adjacent workers' settlements. Gradually they changed into large public utility stations serving the whole district with power after having been connected to the local electric distribution network and frequently also to what may be termed the State grid.

During the first five-year plan a number of existing condensing power stations were also extended for district heating by installing new pass-out turbine sets.

During and after the second five-year plan (1933-37) the development was not only more rapid, but also directed more towards the construction of genuine public utility heat and power stations.

The following table shows the remarkable growth of district heating in Soviet Russia:

	1929	1933	1938	1939
No. of district heating plants.....	14	53	90	106
Heat output per yr. (Btu x 10^{12}).	—	21.8	81.3	87.4
Capacity (10^6kw)	0.056	0.53	1.40	1.75

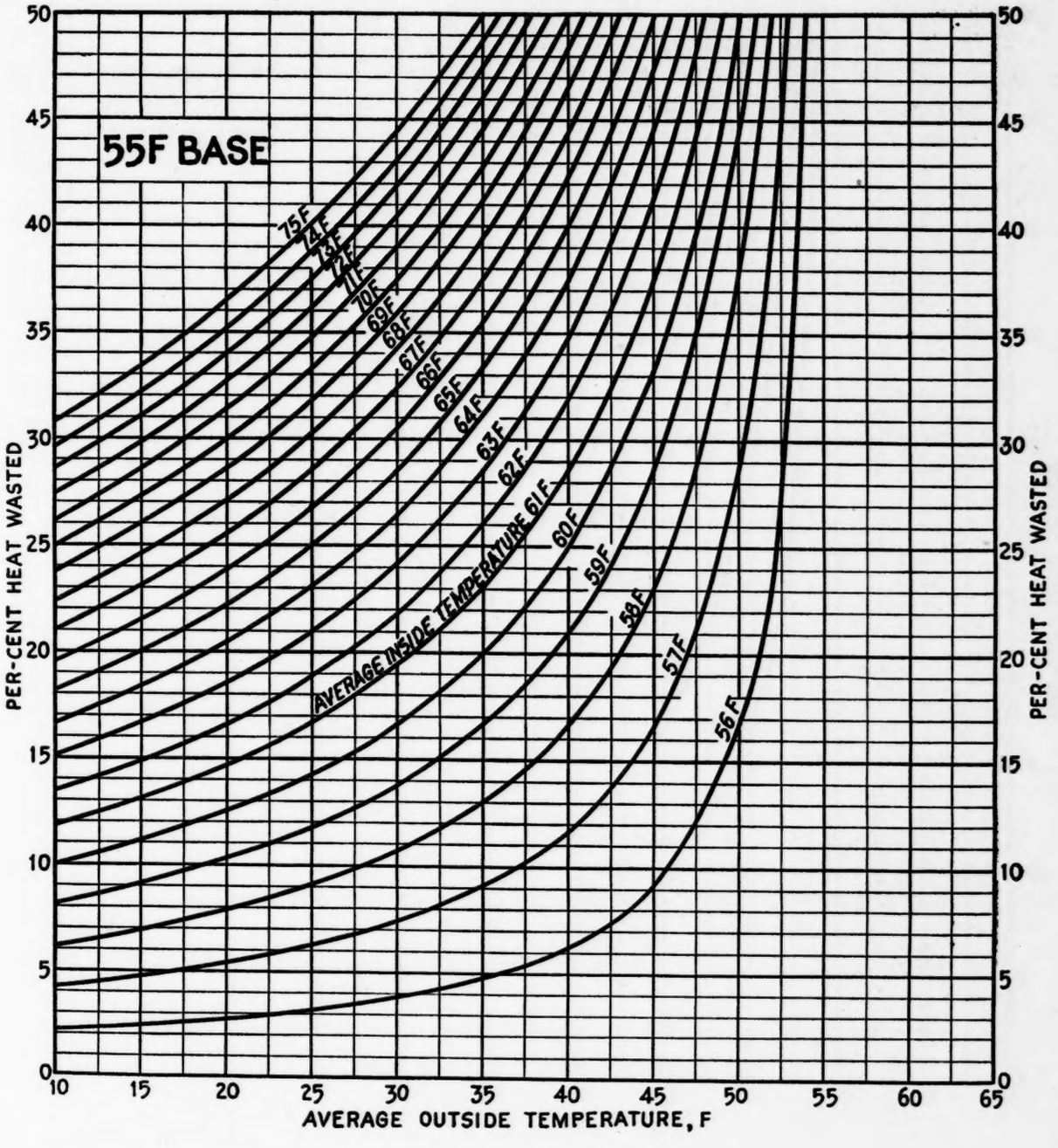
The great majority of Russian heat and power stations operate with initial steam conditions of 515 lb per sq in., 750-840F. These relatively low pressures are apparently due to a standardization at too early a stage. There are, however, a small number of plants operating at pressures between 940 and 2,060 lb per sq in., and two more stations were due to come into operation in 1940, working at 2,060 lb per sq in., 890F.

For space heating and hot water supply, hot water is used almost exclusively as a heating medium in Russia. This pioneer work undertaken in laying out large-scale hot water distribution systems was accompanied by a number of teething troubles. Apart from the disadvantages inherent in hot water distribution, there occurred frequent breakdowns and heavy losses of water through leakage owing to poor design and poor workmanship and also to excessive economy. For example, whereas American and Continental practice always provided conduits or tunnels for the underground piping, the Russians in many instances tried to bury the pipes directly in the soil. While it worked all right in some cases, it caused excessive corrosion in others, and in some instances where the soil was not settled, it led to sagging and leaking of the pipes, and the spotting of the trouble was, of course, made very difficult by the fact that the pipes were buried directly in the soil. But, as a whole, these initial troubles seem to have gradually been overcome.

It seems that a very large proportion of the total heat output is used for industrial purposes. This is reflected in the high average load factor of 40% for 10 of the leading cities. In purely industrial plants higher values are reached (Kasain 76.5%), while in Moscow (33.7%) and Kiev (25%) it is lower on account of the larger proportion of space heating for private dwellings and public buildings. Owing to the colder climate, the load factors are, of course, generally higher than in Western Europe.—*From a paper by Paul G. Kaufman before the Royal Netherlands Institution of Engineers.*

HEAT WASTED BY HIGH INSIDE TEMPERATURES

(Where 24 hr. average inside temperature is normally 55F)



Note that the "Per-Cent Heat Wasted" is in per-cent of the load under the excessive condition. To find how much more heat (or fuel) is being used than would be if 55F were carried, see other side of this sheet.

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HEAT WASTED BY HIGH INSIDE TEMPERATURES

(Where 24 hr. average inside temperature is normally 55F)

The chart on the reverse side of this sheet shows the percentage of heat wasted by carrying excessive inside temperatures. It can be used for either daily or seasonal calculations. Since the chart is based on a 55F temperature, it is usable for many industrial installations where the 24 hour inside temperature average is approximately 55F.

Example: A factory normally heated to 65F during the day and evening hours but with a 24 hour inside temperature of 55F, is being heated to an average inside temperature (24 hr.) of 62F. The temperature outside averages 40F on the day in question. What per cent of the heat is being wasted?

Solution: Locate 40F on the lower scale, move vertically to the curved 62F line, thence horizontally to read 32%. That is, on this day, 32% of the heat is wasted.

To use the chart for a seasonal calculation, refer to Reference Data 255-256 for average outside temperatures during the heating season for the locality in question.

Example: An apartment in Parkersburg, W. Va., normally heated to an average inside temperature of 55F for 24 hours, is being operated with an average temperature (24 hr.) of 63F. How much of the heat is wasted due to too high inside temperature?

Solution: Referring to Reference Data 255-256, the average heating season outside temperature for Parkersburg is 45F. Locate 45F on the lower scale, move vertically to the 63F curved line, thence horizontally to read 44.5% of the heat is being wasted.

Note that the answer is in per cent of the heat load under the excessive condition. In the foregoing example 44.5% of the heat is wasted; this does not mean that 44.5% more heat is being used than necessary. The excess heat $= \frac{X}{100-X}$, where X is the per cent of heat being wasted from the chart, or, in the example $\frac{44.5}{100-44.5} = 80\%$ more heat is being used than would normally be used.

Note also that the chart only applies to buildings whose average 24 hour inside temperature is 55F. The chart is not applicable unless the 24 hr. average inside temperature is known.

Reference Data 263-264 covers buildings where the 24 hr. average inside temperature is 65F.

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NEWS OF THE MONTH

ASHVE Sets Record in Attendance at 50th Annual Meeting

NEW YORK—The 50th annual meeting of the American Society of Heating and Ventilating Engineers, held at the Hotel Pennsylvania here January 30-February 2, established a record with a total registration of 920, of whom 540 were members. At this meeting the ASHVE celebrated a half-century of accomplishments on which the organization congratulated in personal messages, letters, or wires from the secretaries and presidents of the following organizations: American Society of Civil Engineers, American Institute of Architects, American Institute of Electrical Engineers, American Society of Refrigerating Engineers, American Society for Testing Metals, American Standards Association, Engineers Club of Philadelphia, Heating, Piping and Air Conditioning Contractors National Association, Illuminating Engineering Society, Institute of Boiler and Radiator Manufacturers, National Association of Building Owners and Managers, National Association of Fan Manufacturers, Bureau of Standards, National District Heating Association, Smoke Prevention Association of America, Steel Heating Boiler Institute, Bituminous Coal Research, Inc., Stoker Manufacturers Association, Society for Promotion of Engineering Education, American Gas Association, Engineers Society of Western Pennsylvania, Insulation Board Institute, American Physical Society, American Institute of Physics, and the Institution of Heating and Ventilating Engineers of Great Britain.

Honorary memberships were conferred by the ASHVE upon Dr. Willis H. Carrier, chairman of the board, Carrier Corporation, and Dr. Arno C. Fieldner, chief engineer, fuels and explosives service, coal division, Bureau of Mines.

At the annual dinner of the Society the F. Paul Anderson medal was awarded to Dr. Ferry C. Houghten, now on active duty in the U. S. Navy with the rank of Lieutenant-Commander. The award was made to Dr. Houghten for outstanding research over a long period of years.

Before his commissioning by the Navy in 1942, Doctor Houghten was director of Research of the Society which is honoring him, with much of his work dealing with the "effect of the atmospheric environment on man." In the Navy he has been doing research in the air conditioning section of the Bureau of Ships and the research division of the Bureau of Medicine and Surgery.

Doctor Houghten has four children: Captain Robert Lincoln Houghten, U.S.A., meteorologist in the Ferry Command, Army Air Corps; Richard Allen Houghten, Army air cadet; James Wallace Houghten, midshipman cadet in the Merchant Marine Training School; Ruth Marion, the wife of Jack A. Shields, Coast Artillery Officers' Training Corps.

Thomas Chester, consulting engineer, Detroit, was presented with a silver medal awarded by the Institution of Heating and Ventilating Engineers of Great Britain for the best paper presented before the Institution during the period 1937-42. Mr. Chester's paper was on the subject of Drying by Heated Air.

The following officers were elected for 1944: president, S. H. Downs, Clarage Fan Company, Kalamazoo, Michigan; first vice-president, Dr. C.-E. A. Winslow, Pierce Laboratory and Yale University; second vice-president, A. J. Offner, consulting engineer, New York; treasurer, L. P. Saunders, Harrison Radiator Division, General Motors Corporation. Members elected to the Council were C. M. Ashley, L. T. Avery, Professor L. E. Seeley, and G. D. Winans. Members elected to the Committee on Research were Dr. F. E. Giesecke, F. C. McIntosh, Professor G. L. Tuve, Commander T. H. Urdahl, John James, and Mr. Ashley.

The first paper presented at the meeting was entitled Fifty Years in Heating and Ventilating, by S. R. Lewis of Chicago, and in which Mr. Lewis reviewed historical points, particularly in regard to boilers, radiators, fans, and warm air systems. Due to Mr. Lewis' absence, his paper was read by John Howatt.

The second paper was Progress in the Development of Standards for Comfort Air Conditioning, by Lieutenant-Commander Houghten and in which he summarized the present status of comfort air conditioning standards resulting from work by the ASHVE and other organizations.

This paper was followed by a Panel discussion on Future Trends of Heating, Ventilating, and Air Conditioning, conducted by Dr. B. M. Woods of Berkeley, California. The Panel consisted of D. M. DeBard, War Production Board, W. H. Driscoll, Carrier Corp., L. T. Mart, president, The Marley Co., Inc., Kansas City, Commander T. H. Urdahl, U. S. Navy, and C. E. Lewis, sales manager, Delco Appliance Div., General Motors, Rochester, N. Y.

Mr. Driscoll traced the history of ventilation and this was followed by a discussion of ventilation in residences and in transportation equipment. The controversial subject of proper humidification was referred to by Walter Fleisher, following which Mr. Lewis discussed house heating and pointed out the trend toward smaller families, the possible post-war trends in insulation, smaller houses, and their heat losses. His talk resulted in discussion from the floor on the part of numerous members. Mr. DeBard then spoke on coal and fuel conservation and called upon the need for conserving fuel in industrial plants. He suggested (1) that attention be paid to improvement of overall efficiency and operation of heating plants, (2) reduction of air supply to the minimum requirement by health limitations, and (3) utilization of exhaust steam from process works for heating purposes wherever possible.

A Study of Intermittent Heating of Churches was the title of a paper presented by Dr. Giesecke. The author presented a study of the heat requirements of an intermittently-heated church during the heating-up period and in which the maximum rate of flow was 543,000 Btu per hr for intermittent heating in contrast to a maximum flow of 314,000 Btu per hr for continuous operation. Dr. Giesecke's conclusions were (1) A building heated intermittently requires a heating system of considerably larger capacity than the same building heated continuously; (2) The subject of intermittent heating is of sufficient importance to justify additional studies to determine the effects of outdoor temperature, interval between heating periods, length of heating-up period, and the form, size, and type of building.

In the discussion Dr. Carrier stated that it is customary to allow about 50% excess heat for intermittently heated or cooled buildings, to which Dr. Giesecke replied that it was possible to select either the time required for the heating period and determine the excess capacity of the plant or assume the excess capacity and find the time required.

Dr. Carrier and S. W. Anderson were co-authors of a paper Resistance to Heat Flow through Finned Tubing. An abstract of this was presented by Mr. Anderson.

(Continued on next page)

As the result of cooperative research between the ASHVE and Case School of Applied Science, a paper, Control of Air-Streams in Large Spaces, was prepared by Professors G. L. Tuve and G. B. Priester, both of Case. The paper presented results of tests with about 45 sizes and kinds of non-directional discharge outlets which were correlated with data from other investigations. An equation was proposed for the relationship between the velocity at the outlet face, the outlet size and the highest residual velocity at any cross-section of the stream in the room. This maximum residual velocity at a given section was found to be about three times the average velocity at that cross-section. Beyond 25 diameters from the outlet face, and until the maximum velocity falls to less than 500 fpm, the maximum residual velocity in the stream was found to be inversely proportional to the distance from the outlet. Beyond the section where the maximum stream velocity was below 500 fpm, the velocity reduction took place more rapidly.

A jet issuing from a rectangular slot becomes almost circular in shape and follows approximately the same laws as apply to the stream from a round or a square outlet of the same area, although for very narrow slots the entrainment ratio was found to be greater and the throw slightly less. The maximum residual velocity for air streams from very narrow slots (¼ in. to ½ in.) varied inversely as the square root of the distance from the outlet for distances less than 20 diameters. Dividing the outlet area into multiple nozzles or into two or more separate slots made little difference, unless these separate outlets were spaced several inches apart. The effective angle of all straight-flow jets over the major portion of their travel in a room was found to be very close to 20F.

The rating of air filters was the subject of a paper entitled Discoloration Methods of Rating Air Filters, by Professors F. B. Rowley and R. C. Jordan, both of the University of Minnesota, which was discussed at some length by R. S. Dill, Bureau of Standards, James W. May, of Louisville, G. W. Hewitt, East Pittsburgh, and others.

Characteristics of axial-flow fans and a comparison of them with centrifugal fans were discussed in a paper The Axial-Flow Fan and Its Place in Ventilating, by W. R. Heath and A. E. Criqui, both of Buffalo Forge Co. In conclusion the authors said that the true axial-flow fan was born in the aeronautical research laboratory, received its basic training in the Navy, and is ready to join the industrial army. It has fields of application where its use is definitely indicated but, the authors said, it can also be misapplied. It fills a gap in the specific speed chart by providing a high efficiency unit between centrifugal fans and propeller fans. Its range overlaps both of these sufficiently so that it will replace many disk and propeller fans and some centrifugal fans. It is not, however, a universal fan to be indiscriminately applied, the authors concluded, and the choice between an axial-flow and a centrifugal fan must still be intelligently made by the engineer.

A second paper on axial-flow fans, Aerodynamic Development of Axial Flow Fans, by T. H. Troller, was presented.

Major Arthur Nelson, Corps of Engineers, U. S. Army, spoke on Fuel Economy and Army Heating, which was discussed by Captain E. H. Lloyd, of Washington, and others. Retiring-president Merrill Blankin closed the discussion by saying that if savings similar to those obtained by Major Nelson's organization could be applied generally there would be an annual saving of coal in the U. S. of over 400,000 carloads.

George T. Seabury, secretary, American Society of Civil Engineers, spoke on Collective Bargaining for Engineering Employees. Mr. Seabury mentioned that in 1937 when investigating the effects of unionization on engineering employees, a number of pressure groups were found some related to and some independent of the C.I.O. or A. F. of L. The Society finally concluded that the ASCE should consider that such membership (in a trade union) should have no more bearing upon a man's qualifications for membership in the Society than his religious or political affiliations. As a result of investigation made throughout the United States, the board of directors of the ASCE requested the committee on employment conditions to establish a program which included instructions for local sections to make provisions for collective bargaining groups to be composed of and controlled by ASCE members, but including non-members who would be eligible to join the group. At the conclusion of his address Mr. Seabury answered a variety of questions which were asked.

Professors B. F. Raber and F. W. Hutchinson of the University of California were the authors of a progress report on radiant heating entitled Optimum Surface Distribution in Panel Heating and Cooling Systems. The authors measured the area enclosed by a line drawn on a chart by a special integrating instrument emitting a beam of light which was directed around the visible contour of a full sized model representing a human being. The area so determined represented, it was claimed, that proportion of the emitted radiant energy which reached the model. The total radiant heat received from any selected area of emitting surface was obtained by dividing the surface into a large number of small areas and totalling the energy received from each small area.

Determinations of energy received were made for the model representing a standing human figure in a front, 45 deg. front and side view positions, and for a sitting human figure in a front, 45 deg. rear and rear view positions.

It was found that even with a low ceiling (8 ft) the maximum amount of energy reaching an occupant was less than 5% of that emitted by the panel. If the emitting surface was located more than six feet from the model the amount of radiant energy received was less than 2%, and if the distance was eight feet the amount was less than 1%. The radiant energy received from surfaces more than 10 or 15 ft from the occupant was extremely small. An example was given to show how the total radiant energy received from any panel could be calculated.

Charges Railroads Curbed A.C.

WASHINGTON—The railroads are handicapped in the performance of their war task by out-of-date equipment, facilities and operating technique, which could have been modernized if the carriers had not prevented it by monopolistic practices and collusion, Wendell Berge, assistant attorney general, charged February 10 in testifying before a Senate Military Affairs subcommittee, which is considering legislation to establish a Federal Office of Scientific and Technical Mobilization.

Mr. Berge gave numerous examples of successful efforts to discourage the development and use of such new equipment as streamlined trains, air-conditioning and radio, to prevent reductions in rates and adoption of speedier schedules, to restrain the expansion of air cargo transportation and to combat installation on trains of such conveniences as motion pictures.

Charles E. Johnston, chairman of the Western Association of Railway Executives, in a reply to Mr. Berge's charges, asserted that the allegations were "wholly unfounded."

War Construction Nears End

WASHINGTON—At the beginning of 1944, the Corps of Engineers, Army Service Forces, had $172,000,000 of construction work remaining to be completed out of an eleven billion dollar war program begun in June, 1940.

Designed to provide the Army with troop housing, training facilities, and industrial plants, the huge construction program reached its peak intensity last summer. One hundred and eighty-seven major projects, involving estimated expenditures of $112,000,000, comprise the bulk of the total yet to be completed. The remaining $60,000,000 will be required to complete 2,283 jobs classed as minor; that is, costing less than $500,000 each.

Though most of the larger projects will have been completed by the end of March, and practically all presently authorized construction will be in place by the end of June, 1944, a certain amount of routine war construction is anticipated as long as the war continues, due to changing military requirements. An Army airfield designed for pursuit or light bombardment planes, for instance, might be needed to base heavy bombardment; and the conversion would require modification and strengthening of the parking aprons, taxiways, and runways.

The downward trend of new construction, however, is indicated in the dollar volume of work authorized during December, 1943—only 12% of that authorized in the first month of 1943. Barring serious military reverses, the prospects are for a continuation of the downward trend.

Construction incidental to the maintenance and repair of Army installations is estimated at $98,000,000 for the current fiscal year. Included in this budget are items of new construction involving less than $1,000 apiece.

Approximately 1,100 Army posts and sub-posts have been constructed by the Corps of Engineers during the war. For those not required in peacetime, a program of demolition is anticipated. A shortage of lumber and other building materials in demand for post-war construction, undoubtedly will necessitate such a salvage program.

In its civil works program, the Corps of Engineers is compiling a backlog of potential post-war river and harbor, flood control and multiple-purpose heavy construction projects totalling $4,500,000,000. $160,000,000 of this total is included in projects already authorized but deferred to save manpower, equipment, and materials. The remainder of the backlog includes projects approved by Congress and projects recommended to Congress, both contingent upon Congressional appropriation.

Lays Plans for Fuel Program

WASHINGTON—Secretary of the Interior Harold L. Ickes has announced the appointment of a district engineer and eight more coordinators as the Bureau of Mines prepared to carry its fuel efficiency program into the industrial and commercial plants in metropolitan areas within the next few weeks.

The program, directed by the National Fuel Efficiency Council in cooperation with the Bureau of Mines, later will be expanded to include the small fuel consumer. It is a part of the Government's critical resources conservation campaign.

Secretary Ickes said that John G. Mingle, of the Bureau of Mines, has been appointed district engineer by Dr. R. R. Sayers, director of the bureau, and assigned to Indianapolis, Ind., from where he will supervise the program in Michigan, Ohio, Kentucky, and Indiana.

Piping Standards for Rhode Island

PROVIDENCE, R. I.—Establishment of minimum piping standards and provision for the licensing of steamfitters is proposed in a bill introduced Feb. 2 in the Rhode Island Legislature by House Democratic Floor Leader James H. Kiernan.

The bill would create within the State Department of Labor a bureau of steam boiler inspection which would include a board of examiners appointed by the State Labor Director and comprising three members: an inspector from the new bureau, a practical contracting steamfitter, and a practical journeyman steamfitter.

The new board would supervise all high and low pressure steam piping in connection with all building in the state except the building of private residences. It would prescribe minimum standards for piping. No steampiping could be installed except under the direction of a licensed steamfitter.

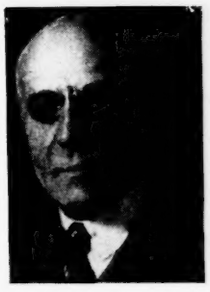
Licenses would be $25 for the original examination and $15 for renewal for a contracting steamfitter, and $5 for examination and $2 for renewal for a journeyman. Firms and individuals presenting evidence that they had been in the steamfitting business for the last five years would not be required to take the examination.

Walter H. Hallsteen

CHICAGO—Walter H. Hallsteen, 53, vice-president and treasurer of Ilg Electric Ventilating Co., died January 15 at Evanston. Mr. Hallsteen joined the Ilg sales staff in 1916. Following the war he was made an assistant on purchasing in the factory office and shortly thereafter was promoted and placed in charge of the purchasing department where he continued until the time of his death.

William O. Vilter

MILWAUKEE—William O. Vilter, 81, president of the Vilter Mfg. Co., died at Columbia hospital Jan. 31 after a lengthy illness. He had been active in affairs of the company for more than 62 years, aiding his brothers, Emil and Theodore, in directing the firm's expanding business in the field of heavy refrigeration and air conditioning equipment.



William O. Vilter

Mr. Vilter was born Feb. 12, 1862, at Fedderwarden, in the grand duchy of Oldenburg, Germany. His parents, Ernest and Elise Vilter, brought their family to Milwaukee in 1871, when William was 9.

His father joined with Peter Weisel in 1879 to form the Weisel & Vilter Co. William joined the firm in 1882 as a bookkeeper and became secretary four years later. The father died in 1888 and William assumed the additional title of treasurer. Five years later the three Vilter brothers bought out Weisel's interests in the firm and the name was changed to the Vilter Mfg. Co. Theodore became president and at his death was succeeded by Emil, who headed the company until 1934, when he was elected chairman of the board and William was named president and treasurer.

Mr. Vilter is survived by his wife and a son, William B. Vilter, director of personnel for the company.

NEWS OF EQUIPMENT AND MATERIALS

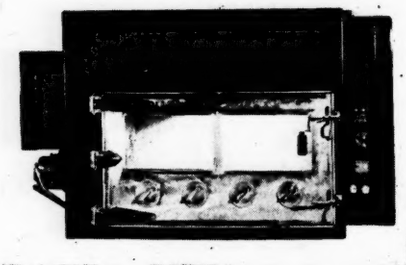
Portable Ventilator

NAME—Herman Nelson self-powered ventilator.
PURPOSE—For portable ventilation in such applications as cooling interior of aircraft for repair work in hot climates, exhausting hot air from

interior of planes, drying out bilges and engine rooms of boats, and similar uses.
FEATURES—Unit consists of a Herman Nelson pressure-type fan, driven by a small gasoline engine or electric motor connected to a collapsible canvas duct through which the air is distributed to the area to be ventilated.
SIZES AND CAPACITIES—Air delivery at 3400 rpm is 4500 cfm without duct assembly attached, and 4000 cfm with duct assembly attached. The whole unit, mounted on wheels, is 24⅝ in. high. Weighing 87 lb., it can be wheeled or lifted by one man.
MADE BY—*The Herman Nelson Corp., Moline, Ill.*

Low and High Temperature Test Chamber

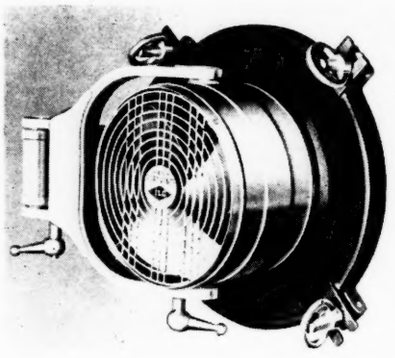
NAME—Model RTC-1 test chamber for high and low temperatures.
FEATURES—When specially ordered, improved machine, which embodies all the features of the standard



Amcoil cabinets, may now be obtained with added advantage of four individually operated plugs in lower panel of door which permit ready access to interior of testing chamber. Turn of the handle opens plug. Hand may be inserted through an insulated passage and position of part being tested can be adjusted. In case of a regulating instrument being tested, its reading may be changed, so that test can be continued without removing it from cabinet, or disturbing other pieces being tested. This eliminates necessity for opening whole door and thus endangering accuracy of test on other parts in chamber. Completely automatic.
SIZES AND CAPACITIES—Can produce whatever temperature is desired between —70C and 158.8C. Can maintain the temperature at any level so that actual service conditions may be created.
MADE BY—*American Coils, Inc., Newark, N. J.*

Porthole Ventilator

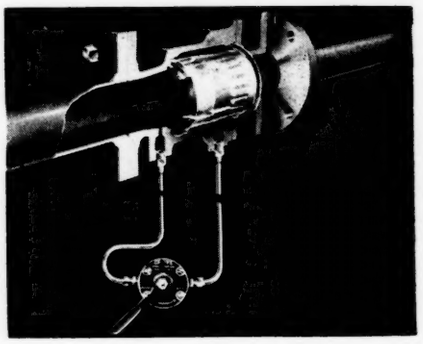
NAME—Ilg Portvente electric porthole ventilator.
PURPOSE—For mechanical ventilation aboard all types of ships.



FEATURES—Fits snugly into porthole through which it draws outside air for ventilation. Has safety grilles on either side of fan unit for protection of operator. Fan operation manually controlled by remotely located two-speed switch. By means of supporting arm with hinge, fan unit can be reversed 180F so as to be used as an exhaust fan. Handle facilitates quick change of position. A third position is when the fan is swung back out of the porthole and locked for use as a circulating fan. This is particularly recommended during heavy weather. Bearing surfaces made of brass, remainder of unit of steel.
SIZES AND CAPACITIES—Model A, designed for 16 in. portholes, has a capacity of 360 cfm supply, 350 cfm exhaust and 67 decibel noise rating; 1/30 hp d.c. motor. Other sizes will be made available.
LITERATURE AVAILABLE—4-page bulletin.
MADE BY—*Ilg Electric Ventilating Co., 2850 N. Crawford Ave., Chicago 41, Ill.*

Remote Control Valve

NAME—Flexflo Remote Control Valve.
PURPOSE—Manually or automatically controlled valve which can be operated hydraulically or pneumatically by various systems, such as manual, electro-solenoid, mechanical or automatic remote control.



FEATURES—Operates on hydraulic principle of balanced or unbalanced fluid line pressure. Since virtually no external force is required, a 12 in. valve can be opened or closed as easily as a 1½ in. valve by the touch of a finger. Designed for cold fluid service, these valves are especially suited for handling water, salt water, chemical solutions, oil, gases, and air. Capacity is considerably greater than that of the globe type of valve on the same pressure drop or loss. Consists of four parts: valve body, flange head, slotted pipe-like core with a solid barrier in the center, and a cylindrical flexible tube.
OPERATION—Flexible tube is stretched tightly over the core. Both tube and core slip into valve body as a unit and are held in place by bolted flange head. Flanged ends of tube serve as gasket sealing off an encircling pressure chamber from the flow stream. Existing fluid pressure in the line forces tube to expand against

the inner wall surface of the valve body, thereby opening the valve and permitting a constantly smooth non-turbulent streamline flow. By opening small remote control valve, line pressure is diverted into the actuating chamber and establishes a pressure balance on the inner and outer walls of the expansible tube. The tube then "flexes" closed over the surface of the core.

SIZES AND CAPACITIES—Made in a wide variety of types and materials, the sizes ranging from 1¼ to 12 in. in diameter and for pressures ranging from 125 to 200 lb per sq in.

LITERATURE AVAILABLE—Bulletin 800.

MADE BY—*Grove Regulator Company, 6545 Green St., Oakland 8, Cal.*

Continuous Combustion Gas Analyser

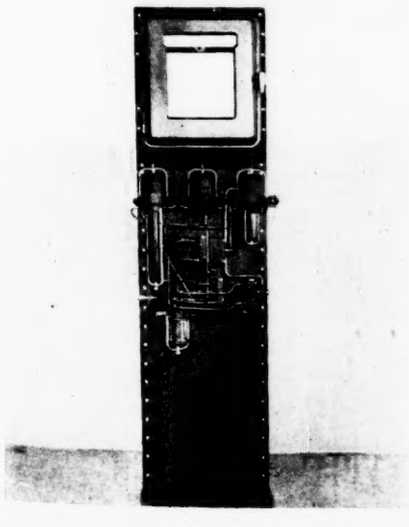
NAME—Cambridge 4-point gas analyser.

PURPOSE—For determining, in combustion gases, the percentages of O_2, CO_2, CO and H_2 simultaneously, and continuously recording the amounts on a single chart.

FEATURES—Analyser operates directly from A.C. line. Recorder may be located any required distance from sampling point and instrument can be furnished with contacts for operating warning signals or to actuate various control circuits. In theory, instrument accomplishes analysis by direct comparison of thermal-conductivity of the sample with that of a reference gas or by comparison of thermal-conductivity of the sample before and after chemical absorption or combustion.

OPERATION—In operation of typical unit, a continuous sample of gas is drawn into the analyser by a water bubbler-aspirator. Details of the analysis procedure varies with constituents of sample but may involve a chemical absorption and/or combustion. Aspirator not only draws in the sample gas but meters it, as well as air which may be required for combustion in analysis procedure. In all applications results are recorded directly without any corrections or interpolation. Upkeep is of routine nature. Continuous record of analysis is provided on a 10-inch strip chart, and the four different registrations (one for each gas) are shown by different colors and numbers on chart.

MADE BY — *Cambridge Instrument Company, Inc., 3732 Grand Central Terminal, New York, N. Y.*



Portable Welders

NAME—Bumblebee AC welder.

PURPOSE—General welding use.

FEATURES—Welder has moisture-proof insulation and is designed to prevent the entrance of rain. Low voltage contactor automatically holds open circuit voltage at 40 volts. When arc is struck, the low voltage contactor closes at once.

MADE BY—*Wilson Welder and Metals Co., 60 E. 42nd St., New York, N. Y.*

Small Blower

NAME—Westinghouse small blower unit.

PURPOSE—Cooling aircraft radio sets.

FEATURES — Recently Westinghouse developed a very small motor to blow cooling air through an air-borne radio set operating on either 400 or 800 cycles at about 7000 rpm with a capacity of 8 cfm. Device has now been modified for aircraft radio sets to run on 60 cycles, and at 3000 rpm. Blower wheel is manufactured by Torrington.

MADE BY — *Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.*

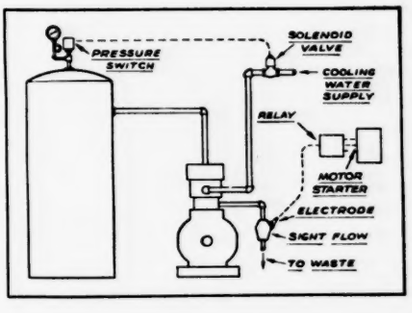
Compressor Control

NAME—Johnson compressor control.

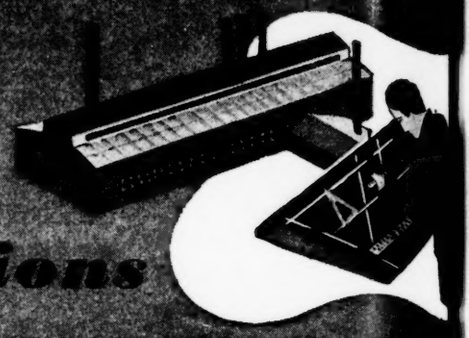
PURPOSE — To protect water-cooled compressors against overheating if operated without cooling water.

FEATURES—Control (type M illustrated) consists of a sight flow fitting mounted in the water discharge pipe of compressor which serves as a holder for a metal electrode. When pressure in the receiver falls below the pre-determined level, pressure switch on receiver opens a solenoid controlled valve to admit cooling water to compressor. Compressor is not started until water flows through it and into the sight flow, completing circuit with the electrode. If for any reason water supply fails compressor will not be started, or if operating will be stopped immediately. Also available in type U for use on unloading compressors. This device insures that cooling water is flowing before compressor starts and stops compressor or sounds alarm if water supply fails.

MADE BY—*Johnson Corp., Three Rivers, Mich.*



REVIEWS of TECHNICAL publications



INDUSTRIAL INSULATION

"Industrial Insulation with Mineral Products," by Oliver Bowles, has been issued by the Bureau of Mines, Washington, D. C., as Information Circular, 7263. Mr. Bowles is Chief of the Nonmetal Economics Division.

The circular describes such materials as mineral wool, asbestos, basic magnesium carbonate, vermiculite, diatomite, and a number of the newer but lesser known products.

Because of the high temperature of steam under pressure, there is a high radiation loss from boilers and pipes unless they are properly protected by some efficient insulating substance.

This report of 17 pages contains reports on the sales of some insulating products in the United States.

LIGHTING HANDBOOK

Because of the demand for information on wartime lighting, Westinghouse Lamp Division, Bloomfield, N. J., has issued a 175-page Lighting Handbook, originally scheduled for release after the war. Designed as a practical guide and working reference book for lighting engineers, designers, architects and builders, the book on lighting was prepared by the Company's Illuminating Engineering Department.

A feature of the handbook is a series of charts which coordinate room index, fixture efficiency and coefficient of utilization curves and provide a new and graphic method of determining the desired illumination for various applications. Charts cover industrial and commercial fluorescent and incandescent lighting and provide a means of calculating quickly the number and size of lamps needed with practically every type of lighting fixture.

The book is divided into two parts, chapter headings in the first section including: Lighting Terms and Measurements, Recommended Levels of Illumination, Interior Lighting Design Calculations, Interior Wiring for Lighting. In the second half of the book, devoted to specific lighting applications, there are chapters covering store, office, school, public buildings, industrial, architectural, aviation and street and highway lighting.

Advance copies of the handbook have been tested in the field and Westinghouse has received orders for it from schools and colleges who plan to use the manual as a textbook in illumination courses. Leatherette cover, size 5 x 7½ in. Price, $1.

BRIEF REVIEWS

FOUNDRY VENTILATION—An entirely new code of recommended practices for the foundry industry, developed by the American Foundrymen's Association industrial hygiene codes committee and approved by the Association's board of directors. It is code 7 in the series developed for fostering foundry safety and hygiene, and gives necessary engineering data and minimum requirements for industrial housekeeping and sanitation.

Large scale employment of women in war production work has focused attention on many problems of ventilation, sanitation, housekeeping, water supply, lighting, etc. This code will provide sufficient data for protecting health and safety and promoting good industrial relations. It is a code every foundry should have available for study and guidance, especially where women are employed.

Price $1 to A.F.A. members, $1.50 to non-members. Available from the Association, 222 West Adams St., Chicago.

COAL DIRECTORY — The twenty-first edition of "MacQuown's Coal Directory and Buyers Guide." Lists coal selling companies, coal operating companies, coke plants, producers and sellers of anthracite, and other information on coal. Published in two editions: standard edition, 800 pages, 9½ x 12 in., $25; abridged edition, $15.

STANDARDS—The American Standards Association has issued a new list of standards covering more than 600 of which 64 have been approved or revised since the last price list was printed (April, 1943). The standards cover specifications for materials, methods of tests, dimensions, definitions of technical terms, procedures, etc.

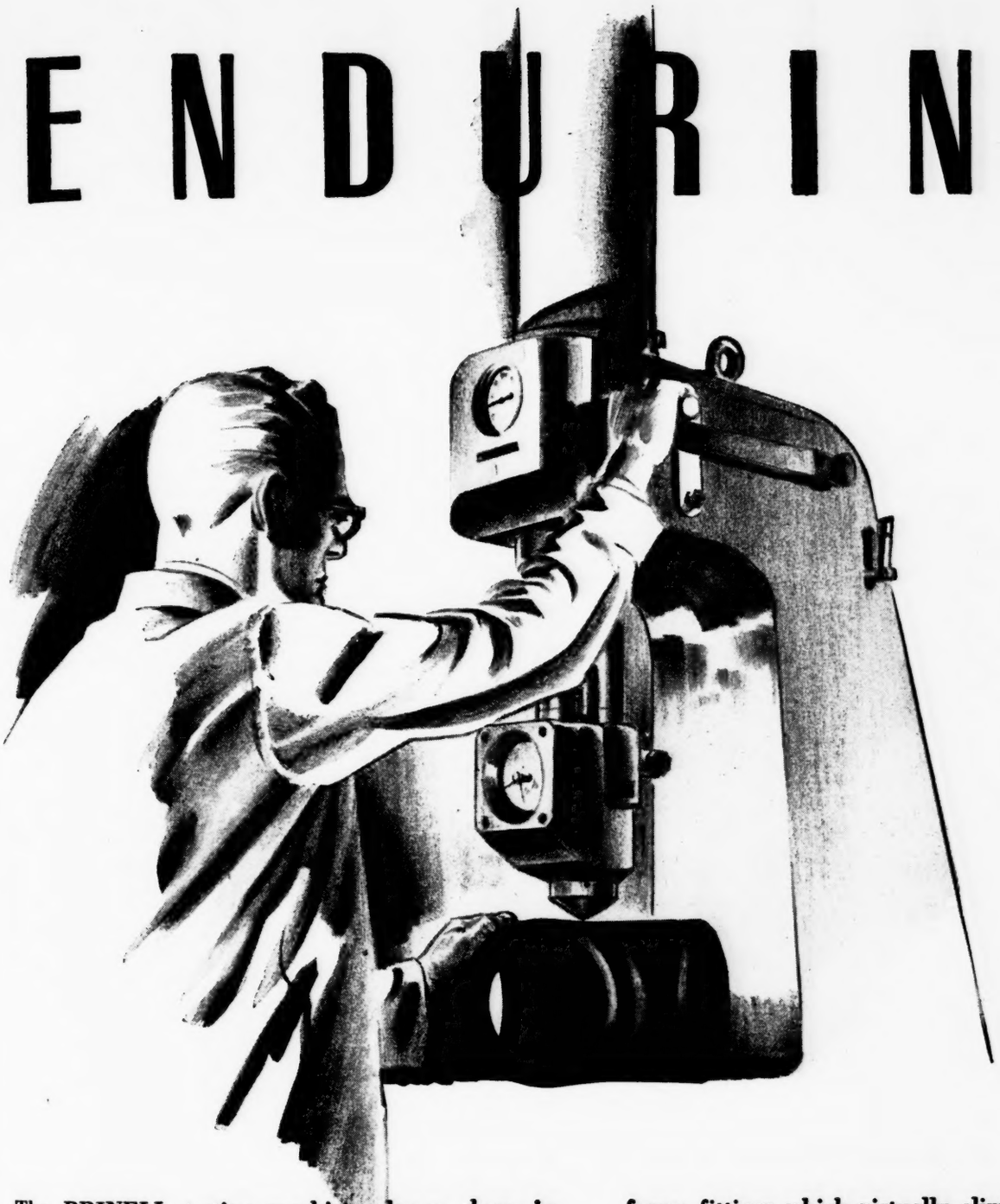
DISTRICT HEATING — The 1943 Proceedings of the National District Heating Association are now available. Price $5.00. Order from Secretary, John F. Collins, 827 North Euclid Avenue, Pittsburgh, Pa.

SAWDUST BURNERS—An 8-page mimeographed leaflet entitled "Report of Investigation of Emergency Fuels for Domestic Sawdust Burners," published by the School of Forestry, Oregon State College, Corvallis, Ore.

PREFABRICATION—An 80-page bulletin entitled "A History of Prefabrication" and one of the series of the publications of the Pierce Foundation. The material in the bulletin is a series of reprints from the *Architectural Forum* and comprehensively covers prefabricated houses. Paper covered, 9 x 12 in., published by the John B. Pierce Foundation, 40 W. 40th St., New York 18, N. Y. Price, 75c.

FINANCING EQUIPMENT—Use of the instalment financing device in the purchase of commercial and industrial equipment may contribute much toward meeting the post-war problems of reconversion and expansion. Its extensive use by industrial and commercial concerns appears probable because the procedure makes it possible for the machinery or equipment to be paid for out of income which it helps to produce. This lightens the burden on the purchaser, and enables the financing agency to carry a minimum risk during the pay-out period because of the systematic reduction in the amount of debt involved. These findings are included in a booklet issued by the National Bureau of Economic Research, entitled *Financing Equipment for Commercial and Industrial Enterprise*. The authors of the report are Professor Neil H. Jacoby, Secretary, University of Chicago, and Professor R. J. Saulnier of Barnard College, Columbia University. Size, 6 x 9¼ in., cloth-bound, 95 pp., 10 tables, 3 charts. Price, $1.50. Obtainable from the Bureau, 1819 Broadway, New York, N. Y.

ENDURING



The BRINELL testing machine, shown above in Tube Turns' laboratories, scientifically determines the hardness, or wear resistance, of finished fittings.

Endurance is indispensable in welding fittings, for the destructive forces in piping — strain, pressure, vibration, corrosion and erosion — are more *highly concentrated at the fittings.*

Tube Turns' exclusive manufacturing process forges fittings which virtually eliminate premature wear, leakage, and maintenance throughout the life of piping. Systematic hardness tests *insure* the enduring qualities possessed by all Tube-Turn seamless welding fittings.

TUBE TURNS (Inc.) Louisville, Kentucky. *Branch Offices: New York, Chicago, Philadelphia, Pittsburgh, Cleveland, Dayton, Washington, D. C., Houston, San Francisco, Seattle . . . Distributors located in all principal cities.*

ARMY E NAVY M

TUBE-TURN

TRADE MARK

Welding Fittings and Flanges

WITH THE MANUFACTURERS

IRON FIREMAN MFG. COMPANY

experienced a $2 million loss when its Industrial Division in Portland, Ore., was destroyed by fire February 2. The plant had been producing engines for Liberty ships for the past two years and had received an "M" award and gold star from the Maritime Commission. The cause of the fire was not immediately determined.

THE McCARTY COMPANY

1206 Maple Ave., Los Angeles 15, Calif., advertising counsellors, is celebrating its silver anniversary. The agency was founded in 1919 by T. T. McCarty, and handles more than 50 of the Pacific Coast's largest industrial advertisers.

THE SHEFFLER-GROSS COMPANY

announces that Harold M. Miller has joined its organization as field engineer. Mr. Miller spent ten years with the Sinclair Refining Company at Marcus Hook in connection with maintenance and repair of instruments and controls. In the last few years, previous to joining this company, he was with the Blaw-Knox Company, Pittsburgh, in connection with the synthetic rubber program, where he was engaged in the design, supervision and installation of instruments and controls.

J. A. WALSH & CO., INC.

is the new name of the former Air Conditioning Company, distributors and engineers, 3215 McKinney Ave., Houston, Texas. The change became effective January 1. James A. Walsh, who continues as the president, stated that the change in name made no changes in its management or personnel but that capitalization has been increased to allow for post-war expansion plans.

WORTHINGTON PUMP AND MACHINERY CORP.

Harrison, N. J., has appointed William O. Wilson of Evanston, Ill. as commercial vice-president.

O. D. JENNINGS & COMPANY

Chicago, manufacturers of refrigerated vending equipment, has appointed E. A. Terhune as vice-president, assistant to the president, and a director of the company. Mr. Terhune recently resigned as sales manager of the electric refrigeration and air conditioning division of Servel, Inc., to take up this new position. He has been active in the refrigeration industry since 1926, when he joined Frigidaire in New England and was retail sales manager. Subsequently he formed his own distributing organization, Appliance Engineering Company, Boston. He joined Servel ten years ago, operating first as Eastern manager, and in 1939 was appointed sales manager, with headquarters at Evansville, Ind.

HAMMEL RADIATOR ENGINEERING CO.

3348 Motor Ave., Los Angeles, has appointed L. M. Hull as sales manager of the heating division. Mr. Hull, a heating engineer with long experience in the design and merchandising of gas and oil heating equipment, has been assigned to developing post-war heating equipment and laying plans for national extension of the company's sales activities. His previous experience was with Payne Furnace & Supply Co. and Pacific Gas Radiator Co.

JOSEPH T. RYERSON & SONS, INC.

on February 1st purchased from the Bethlehem Steel Company its Pittsburgh steel warehouse plant. The property consists of a large modern warehouse building, containing 150,000 square feet on an industrial site of several acres.

PERSONALS AND PERSONNEL

JAMES PURVIS

James Purvis

for the past several years associated with consulting engineers throughout the country, has been named plant superintendent and assistant works manager of the Marion (Ohio) plant of Universal Cooler Corporation. Mr. Purvis assumed his new duties January 12, and comes to Universal Cooler from the engineering firm of Giffels and Valet, Detroit. This closely follows President Frank S. McNeal's appointment of A. E. Knapp as works manager.

J. J. DONOVAN

has been named regional manager of the Chrysler Airtemp New York office. Mr. Donovan will direct Airtemp sales and service activities in the greater New York area and New England. Since 1941 Mr. Donovan has been associated with WPB in Washington, as assistant director of the automotive division. Prior to that Mr. Donovan had wide experience in the refrigeration and air conditioning industry, entering the refrigeration business in 1923 with Frigidaire. He later joined the electric refrigeration department of the General Electric Co. as district manager of the Pittsburgh district. He was appointed manager of G.E.'s apartment house and new construction division of the company's electric refrigeration department. In 1932 he was appointed manager of the air conditioning department, setting up the initial organization for General Electric's entry into this field. Mr. Donovan served in this capacity until 1939, when he formed his own company, Wildon, Inc. During 1940 he was associated with Servel, Inc., on a special assignment.

PAUL B. REED

formerly service manager of the electric refrigeration and air conditioning division of Servel, Inc., Evansville, Ind., has joined the Perfex Corporation, Milwaukee, as manager of its refrigeration and air conditioning division. In his new work, Mr. Reed will correlate the engineering, production and sales of Perfex' new line of refrigeration controls and accessories added to the Perfex line of general heating controls, stoker and oil burner controls, damper operators and other accessory devices, well known in the heating field. Perfex plans to not only build a line of refrigeration controls and accessories but also to lend assistance to their customers in the proper application of control apparatus and in all related problems. Temporarily Mr. Reed's office will be in the Perfex engineering department building at 710 South Third Street.

Paul B. Reed

LEO. J. FREITAS

of Dallas, returned in January to his duties as field engineer in the Texas and Oklahoma territory for the Alco Valve Co., St. Louis, after a leave of absence since July, 1942, with the War Production Board in Washington. His headquarters in Dallas are at 5719 Redwood Lane.

Serving WPB in the refrigeration section, general industrial equipment division, he assisted in the administration of Orders L-38 and M-28 and later was chief of the refrigerant and accessories unit.

sound engineering

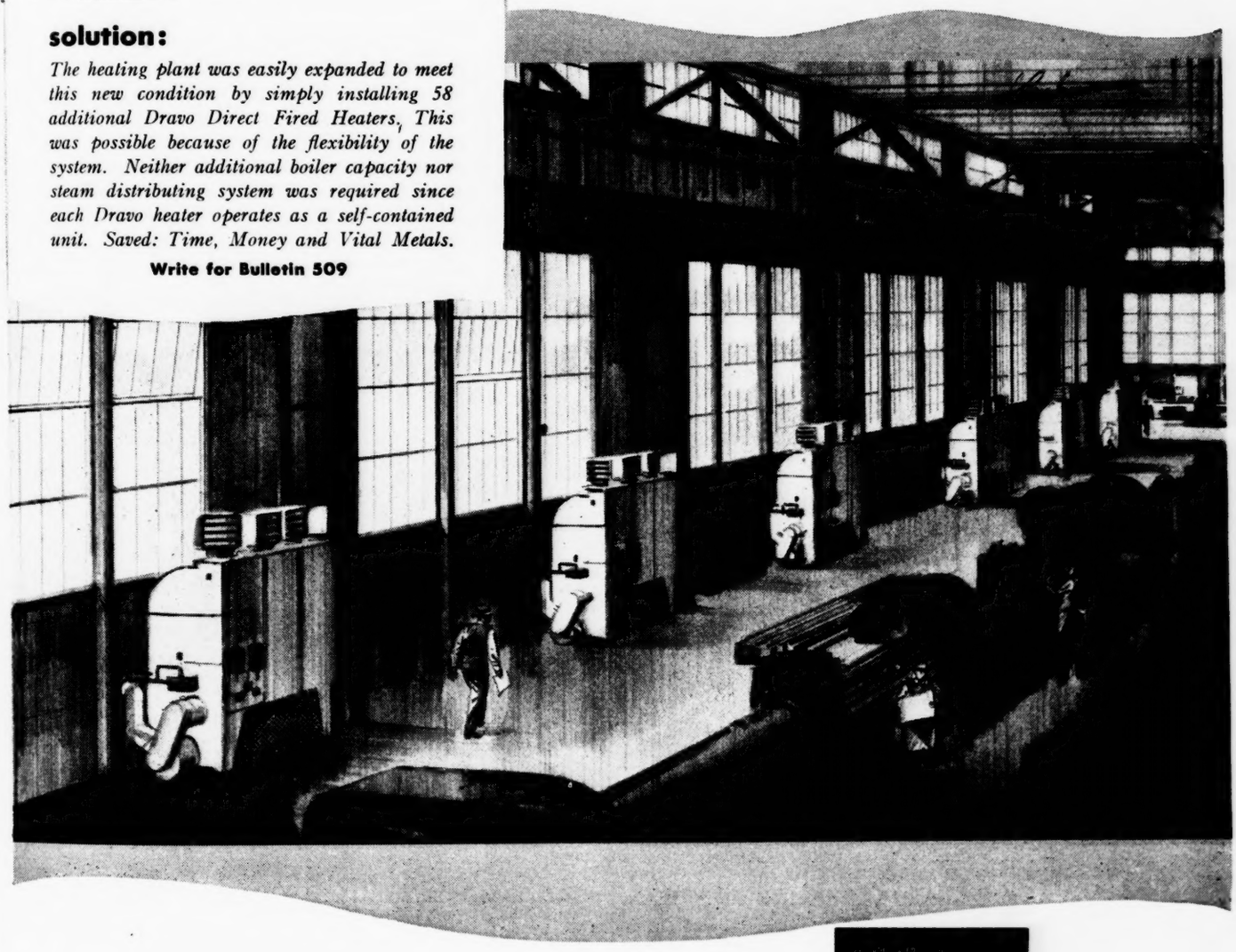
22 Dravo Heaters replaced Steam Heat successfully . . . but enlarge the building 500% . . . what then?

Naval ordnance engineers posed this question in changing an old heavy armament plant to new construction. Full capacity of the present steam boiler was required for processing; leaving no steam for heating. Heat loss, in enlarging the building, rose from 22,000,000 B.t.u. to 80,000,000 B.t.u. and was further complicated by unusually high ceilings, measuring 74 ft. to the roof trusses. How to heat this huge plant—and quickly?

solution:

The heating plant was easily expanded to meet this new condition by simply installing 58 additional Dravo Direct Fired Heaters. This was possible because of the flexibility of the system. Neither additional boiler capacity nor steam distributing system was required since each Dravo heater operates as a self-contained unit. Saved: Time, Money and Vital Metals.

Write for Bulletin 509



DRAVO CORPORATION · PITTSBURGH

DRAVO Heating

JOHN H. SEIPPEL

has been appointed vice-president and general manager, Hoffman Specialty Company. He entered the heating and plumbing fields 27 years ago with the Haynes organization, Philadelphia.

John H. Seippel

A. E. SCHWARZ

formerly with Electric Bond and Share Co., has rejoined the organization and is now located at Ebasco Services, Inc., 2 Rector St., New York, N. Y. He returned to Electric Bond and Share in the re-organization of Ebasco Services, Inc. to meet the post-war needs of clients. These plans include selection of specialists to head up departments in each field of service. Mr. Schwarz's experience includes work with Westinghouse Electric & Mfg. Co., Minnesota Power and Light Co., and Bryant Heater Co.

HAROLD W. WINNINGHAM & CO.

Western Sales representative and engineers for manufacturers, with general offices at 1117 Second Avenue, Seattle, Wash., have appointed Lawrence J. Coman, Southwest district manager, with headquarters at Los Angeles. The firm also announces opening of new Southwest district offices and display rooms at 633 South La Brea, Los Angeles.

BURTON M. SHARPE

service engineer of Surface Combustion, Cleveland, Ohio, has been assigned to India to supervise installation of the company's high altitude aircraft heater in military airplanes.

J. HARRY EBBERT

who recently resigned as vice-president and general manager of the Armstrong Company, has been elected vice-president of Grant Wilson, Inc., 4101 West Taylor St., Chicago, Ill. He will make his headquarters in the Chicago general offices.

J. Harry Ebbert

Mr. Ebbert, during the last 15 years, has served as Manager of the Armstrong Chicago and Dallas plants and more recently as vice-president, directing the company's sales, research and production from their Detroit offices.

The new activities of Mr. Ebbert will include sales direction, an active participation in post-war planning, and the development of new markets for the asbestos and insulating materials offered by the Company.

A. E. KNAPP

associated with the Nash-Kelvinator Corporation for the past 18 years, has been appointed works manager of Universal Cooler Corporation, Marion, Ohio.

A. E. Knapp

LESLIE E. GAUT

formerly of Cleveland, Ohio, has been appointed general sales manager of Victor Electric Products, Inc., Cincinnati. He will develop the company's post-war planning, marketing and merchandising. The company manufactures ventilating equipment, fans, and small motors, but is now entirely engaged in war production.

DIRECT FIRED HEATERS

Dravo Corporation, Machinery Division—Heater Department, 300 Penn Ave., Pittsburgh, Pa.

A 16-page bulletin 509, standard size, and giving a complete résumé of information on Dravo's direct-fired heaters. The booklet is divided into six parts; the first shows the small requirement of critical materials and floor space used by this system; the second is devoted to the efficiency of the unit; the third, heat distribution; fourth, cleanliness of the heat for improving working conditions in production; fifth, unit's universality in regard to fuel; sixth, flexibility and ease of expansion. Cutaway drawings, dimensional, and capacity data conclude the booklet.

MAINTENANCE

Oakite Products, Inc., 57 Thames St., New York 6, N. Y.

Maintenance of air conditioning and humidifying equipment in industrial plants is discussed in the feature article of the January-February, 1944, issue of Oakite News Service. Stressing the fact that regular care and attention must be given to all the various units that make up air conditioning installations, the article gives data on how effective cleaning and related techniques help solve problems of scale, slime, odors and corrosion. Case histories and results are included.

PROPELLER FANS

The Bishop & Babcock Mfg. Co., 4901 Hamilton Ave., N.E., Cleveland 14, Ohio.

A standard size, loose-leaf-punched, 8-page bulletin 96, devoted to the company's line of Massachusetts propeller fans and giving dimensional, capacity and other information on direct-drive propeller fans, belt-drive propeller fans, automatic shutters, and fan houses.

PUMPS

Aurora Pump Company, Aurora, Ill.

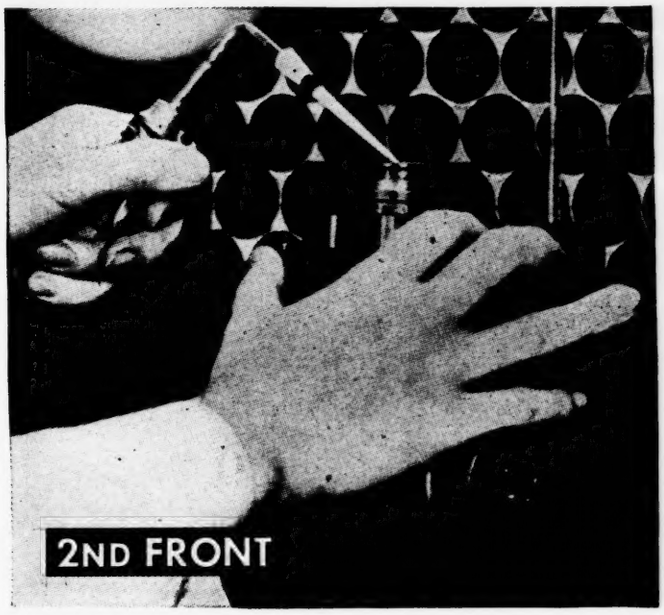
A standard size, 12-page catalog in condensed form on the company's line of turbine type and centrifugal pumps. A full page with photographs, drawings, specifications, capacity data, and comprehensive data on each of the following types of pumps: turbine type, double suction; centrifugal horizontally split case, double suction; centrifugal horizontally split case, single suction; centrifugal side suction single stage, non-clog; horizontal and vertical, single suction; mixed flow, large capacity, low head; sump pumps, heavy and light duty; condensation return units, horizontal and vertical type; and deepwell turbine pumps and jet water systems.

INDUSTRIAL DEGREE DAYS
December, 1943 and January, 1944

City	Number of Industrial Degree Days			
	55F Base		45F Base	
	Dec.	Jan.	Dec.	Jan.
Baltimore	553	532	276	257
Buffalo	878	785	568	478
Chicago	853	731	543	444
Cleveland	771	679	461	392
Detroit	855	753	545	459
Indianapolis	756	637	458	355
New York	698	647	396	341
Philadelphia	615	593	320	302
Pittsburgh	721	620	418	333
St. Louis	696	547	399	275

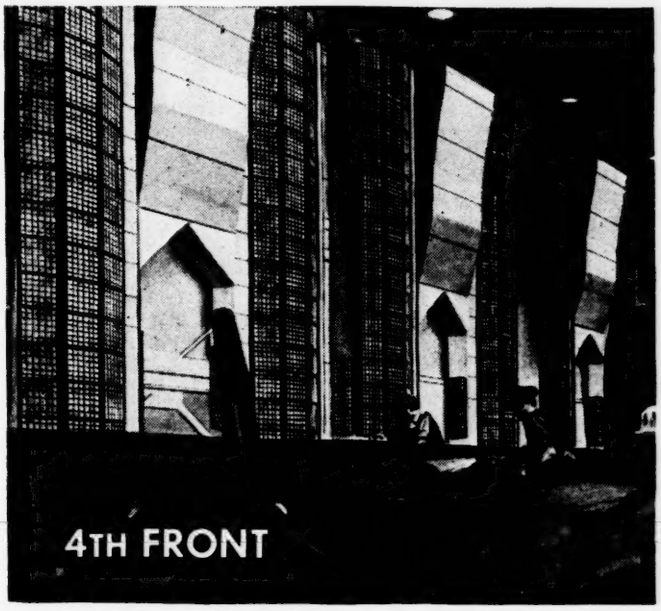
How to defeat one enemy on four fronts

Dust is the deadly enemy of electric motors. To keep dust out of the motor shown above Dust-Stop* Air Filters were installed in front of the blower fan so that the air used for cooling the motor would be free from damaging dirt and grime.



Dust also is the enemy of precision instruments. That's why the girl shown above is working in a current of air blown through Dust-Stop Air Filters. This prevents dust or grit from settling on the delicate parts she is assembling.

In draughting rooms, laboratories, machine shops, and offices, dust-laden air is an enemy of efficiency. Employers know that Dust-Stop-equipped air-conditioning systems increase efficiency.



Dust is also the enemy of freshly painted surfaces. That's why Dust-Stops were installed in the world's largest paint spray booth to keep the air clean . . . surfaces flawless.

The above are only a few of the many "fronts" on which Dust-Stops are serving war industries today—and will serve peacetime industries tomorrow.

Find out how economically these filters can help defeat the enemy dust. For complete information, write *Owens-Corning Fiberglas Corporation, Toledo 1, Ohio. In Canada, Fiberglas Canada, Ltd., Oshawa, Ontario.*

FIBERGLAS*

DUSTOP

*T. M. Reg. U. S. Pat. Off.

AIR FILTERS

ARMY E NAVY

Degree-Days for January, 1944

HEATING AND VENTILATING'S 16th year of publication of monthly degree-day data

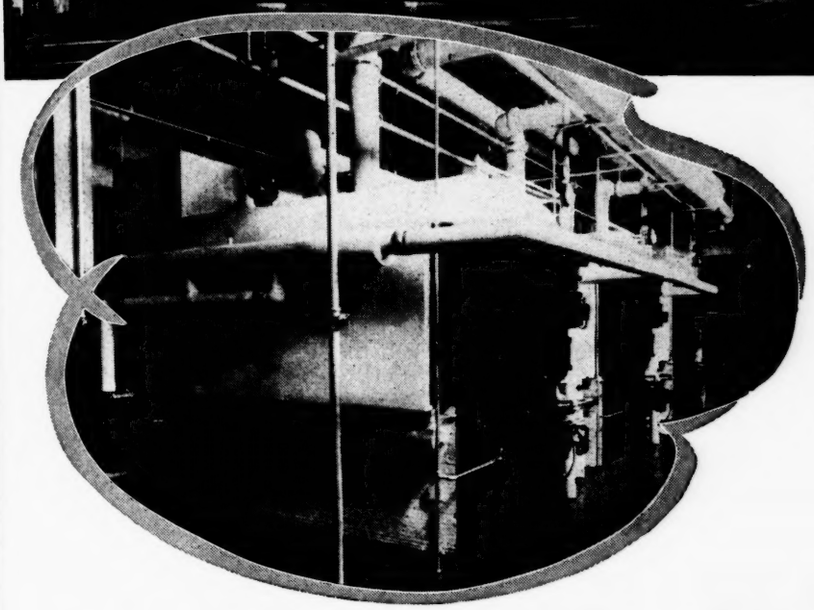
City	Monthly Degree-Days			Cumulative Degree-Days[1]			Year[2]
	Degree-Days, Jan., 1944	Degree-Days, Jan., 1943	Degree-Days, Jan., Normal	Season, 9/1/43-1/31/44	Season, 9/1/42-1/31/43	Season, Normal, 9/1-1/31	Normal, 9/1-6/30
Abilene, Texas	595	623	326	1648	1523	1251	2061
Albany, New York	1173	1463	1287	3997	4167	3726	6580
Albuquerque, New Mexico	1115	819	924	3023	2316	2751	4298
Alpena, Michigan	1135	1469	1431	4182	4427	4382	8299*
Anaconda, Montana	1250	1444	1321	4209	4508	4492	8357**
Asheville, North Carolina	792	730	831	2631	2386	2520	4232
Atlanta, Georgia	635	586	682	1883	1709	1813	2890
Atlantic City, New Jersey	900	948	992	2698	2565	2727	5176
Augusta, Georgia	539	486	555	1506	1318	1441	2161
Baker, Oregon	1253	1345	1218	3755	3990	4033	7163
Baltimore, Maryland	831	932	955	2557	2543	2619	4533
Billings, Montana	1062	1593	1318	3396	4251	4134	7119
Binghamton, New York	1125	1307	1268	3967	3831	3783	6808
Birmingham, Alabama	631	552	589	1990	1494	1502	2352
Bismarck, North Dakota	1232	2074	1807	4176	5658	5321	9192
Block Island, Rhode Island	1002	1105	1048	2977	3084	2784	5788
Boise, Idaho	1244	1141	1097	3398	3386	3382	5552
Boston, Massachusetts	1051	1226	1150	3271	3395	3280	6045
Bozeman, Montana	1326	1537	1403	4304	4589	4689	8521**
Buffalo, New York	1095	1357	1240	3813	3850	3612	6822
Burlington, Vermont	1372	1604	1429	4455	4602	4202	7514
Butte, Montana	1378	1580	1309	4617	4949	4492	8272
Cairo, Illinois	802	860	908	2509	2341	2407	3909
Canton, New York	1321	1739	1520	4536	4781	4514	8020
Charles City, Iowa	1165	1652	1560	4189	4754	4455	7588
Charleston, South Carolina	472	454	487	1277	1092	1119	1769
Charlotte, North Carolina	683	648	725	1956	1864	1945	3120
Chattanooga, Tennessee	765	657	732	2332	2004	1957	3118
Cheyenne, Wyoming	1167	1153	1215	3884	3929	4104	7466
Chicago, Illinois	1041	1312	1274	3597	3904	3193	5957
Cincinnati, Ohio	894	951	1017	2972	2935	2813	4684
Cleveland, Ohio	987	1153	1181	3340	3353	3366	6155
Columbia, Missouri	933	1105	1110	3104	3062	3006	4922
Columbia, South Carolina	576	524	586	1620	1434	1502	2364
Columbus, Ohio	962	1026	1113	3162	3121	3133	5398
Concord, New Hampshire	1315	1515	1349	4256	4375	4081	7353
Concordia, Kansas	941	1209	1184	3156	3398	3203	5315
Dallas, Texas	598	616	617	1632	1479	1487	2256
Davenport, Iowa	1015	1382	1352	3491	3923	3685	6289
Dayton, Ohio	1013	1027	1116	3400	3126	3063	5264
Denver, Colorado	1011	938	1079	3055	3038	3355	5874
Des Moines, Iowa	1038	1428	1392	3617	3991	3762	6384
Detroit, Michigan	1062	1342	1252	3649	3835	3584	6490
Devils Lake, North Dakota	1433	2167	1949	4847	6089	5820	9970
Dodge City, Kansas	1065	985	1116	3235	2978	3068	5035
Dubuque, Iowa	1094	1493	1442	3788	4251	3976	6790
Duluth, Minnesota	1335	1842	1727	4908	5496	5216	9443
Eastport, Maine	1251	1472	1380	4167	4404	4270	8520**
Elkins, West Virginia	1011	921	1048	3540	3083	3265	5697
El Paso, Texas	748	639	629	1899	1468	1667	2428
Ely, Nevada	1438	1230	—	4211	4078	—	—
Erie, Pennsylvania	1044	1217	1172	3476	3455	3336	6273
Escanaba, Michigan	1215	1553	1550	4385	4752	4688	8771*
Evansville, Indiana	889	964	949	2938	2840	2494	4244
Fort Smith, Arkansas	731	764	850	2102	1948	2027	3147
Fort Wayne, Indiana	1078	1295	1194	3770	3846	3405	5925
Fort Worth, Texas	572	625	580	1581	1482	1406	2148
Fresno, California	562	606	583	1533	1648	1494	2334
Galveston, Texas	374	363	353	892	667	683	1016
Grand Junction, Colorado	1215	1011	1233	3163	2977	3511	5548
Grand Rapids, Michigan	1053	1348	1262	3659	3840	3659	6535
Green Bay, Wisconsin	1185	1590	1538	4236	4613	4420	7825
Greensboro, North Carolina	812	748	772	2490	2293	2167	3529
Greenville, South Carolina	671	628	744	1986	1851	2078	3380
Harrisburg, Pennsylvania	1001	1061	1088	3177	3107	3069	5375
Hartford, Connecticut	1106	1256	1159	3575	3603	3316	6036
Hatteras, North Carolina	641	563	589	1661	1330	1316	2571
Havre, Montana	1159	1898	1624	3865	5148	4938	8700
Helena, Montana	1292	1814	1375	4323	4841	4433	7898
Houston, Texas	374	409	366	981	825	815	1157
Huron, South Dakota	1251	1856	1650	4160	5101	4735	8004
Indianapolis, Indiana	942	1141	1128	3171	3262	3130	5298
Kansas City, Missouri	898	1134	1141	3008	3100	3007	4956
Kewanee, Illinois	1093	1396	1223	3759	4091	3534	6139
Knoxville, Tennessee	748	701	815	2380	2170	2298	3670
La Crosse, Wisconsin	1138	1708	1535	4250	4691	4313	7322
Lander, Wyoming	1667	1324	1436	4705	4407	4511	7947

[1]Cumulative data identical with monthly figures for September only. In subsequent months, cumulative figures will show record for whole heating season to and including month in question.

[2]Figures in this column are normal totals for a complete heating season, September to June, incl.

Figures in this table, with eight exceptions, based on local weather bureau reports. Exceptions are Utica, Lewiston, Kewanee, and Sioux City, figures for which are furnished through the courtesy of Coke Sales Department, Central New York Power Corp., Utica, N. Y.; Norman E. Ross, Bursar, Bates College, Lewiston, Me.; J. M. Hartman, Engineering Department, Kewanee Boiler Corp., Kewanee, Ill., and Alfred R. Wagstaff, Engineer, Sioux City Foundry and Boiler Co., Sioux City, Iowa, respectively; Anaconda, Bozeman, Butte and Livingston, Mont., through the courtesy of the Montana Power Company.

[Table Concluded on page 96]



Junior and Senior High School, Harrison, N. Y. Architect, Robert Vignola, Harrison, N. Y.; Consulting Engineers, Daniel & Wallen, New York City; Heating Contractor, John Winkel Co., Inc., Larchmont, N. Y. Boiler Plant consists of three 20-section No. 60 Smith Cast Iron Header Type Boilers.

Boiler Plant...

for the POST WAR SCHOOL

City school operating officials are obviously in a favorable position to compare fuel and maintenance costs of various types of heating systems. Basing their findings on long term studies of these operating expenses it is significant that more and more school departments regularly specify H. B. SMITH boilers as standard equipment for their buildings.

Architects and Engineers who are now confronted with the specification of heating systems for public schools to be built post war would do well to study installations in like projects erected immediately pre-war to find the answers to many of their questions.

It is our prediction that as far as actual heat generation is concerned, the boiler plant of the 194? school will closely resemble the best installations of 1941. Recently built schools such as Westchester's Harrison High have set the standard for post war school heating.

H. B. SMITH cast-iron boilers installed in hundreds of recently built schools have not only been capable of that flexibility of performance needed by modern heating and air conditioning systems, but have proven themselves adaptable to the use of different fuels and methods of firing forced by the events of the last three years. Despite reductions in the amount of fuel available these SMITH boilers have operated with characteristic economy, reflecting credit on both their specifiers and installers.

It is this proven performance that makes an H. B. SMITH specification the best bet for today's planners of tomorrow's schools.

Complete engineering data and specifications of H. B. SMITH Boilers are filed in the Domestic Engineering Directory and Sweet's "Engineering."

H.B. *Smith*
CAST-IRON BOILERS

THE H. B. SMITH COMPANY, INC. • WESTFIELD, MASS.
Branch Offices and Sales Representatives in Principal Cities

Degree-Days for January, 1944 (Concluded)

HEATING AND VENTILATING'S 16th year of publication of monthly degree-day data

City	Monthly Degree-Days			Cumulative Degree-Days[1]			Year[2]
	Degree-Days, Jan., 1944	Degree-Days, Jan., 1943	Degree-Days, Jan., Normal	Season, 9/1/43-1/31/44	Season, 9/1/42-1/31/43	Season, Normal, 9/1-1/31	Normal, 9/1-6/30
Lansing, Michigan	1142	1413	1336	4035	4159	4001	7048
Lewiston, Maine	1407	1492	1452	4561	4438	4289	7707
Lincoln, Nebraska	971	1339	1311	3331	3730	3512	5999
Little Rock, Arkansas	695	721	719	2054	1905	1798	2811
Livingston, Montana	1111	1398	1220	3590	4183	3951	7205
Los Angeles, California	261	229	326	617	583	750	1504
Louisville, Kentucky	824	896	939	2665	2654	2526	4180
Lynchburg, Virginia	759	741	856	2352	2280	2413	3980
Macon, Georgia	540	491	549	1624	1338	1446	2201
Madison, Wisconsin	1167	1550	1500	4077	4494	4258	7429
Marquette, Michigan	1170	1551	1500	4325	4723	4554	8693*
Memphis, Tennessee	710	732	744	2153	1907	1871	2950
Meridian, Mississippi	559	522	552	1673	1351	1435	2160
Milwaukee, Wisconsin	1156	1439	1383	4015	4304	3984	7245
Minneapolis, Minnesota	1194	1771	1609	4263	4989	4550	7850
Modena, Utah	1306	1095	1187	3700	3477	3859	6562
Montgomery, Alabama	494	448	515	1452	1161	1284	1884
Nantucket, Massachusetts	997	1100	1026	2967	3075	2938	5957
Nashville, Tennessee	772	760	812	2385	2151	2175	3507
New Haven, Connecticut	1061	1166	1110	3381	3297	3219	5895
New Orleans, Louisiana	369	361	332	977	739	735	1024
New York, New York	957	1058	1060	2954	2902	2909	5347
*Nome, Alaska	1832	2209	1857	4905	5485	5236	14580**
Norfolk, Virginia	723	675	738	2013	1772	1933	3350
North Head, Washington	633	799	725	2171	2510	2510	5452**
North Platte, Nebraska	1109	1212	1300	3463	3636	3786	6366
Oakland, California	493	507	527	1482	1596	1626	3143**
Oklahoma City, Oklahoma	780	859	865	2240	2217	2244	3613
Omaha, Nebraska	1035	1396	1355	3551	3881	3639	6131
Oswego, New York	1152	1384	1277	3875	3924	3771	7088
Parkersburg, West Virginia	945	909	992	3075	2812	2822	4775
Peoria, Illinois	1056	1262	1283	3625	3731	3606	6109
Philadelphia, Pennsylvania	903	1002	1001	2730	2762	2736	4855
Phoenix, Arizona	408	358	409	893	734	990	1405
Pittsburgh, Pennsylvania	930	985	1054	3154	2988	3003	5235
Pocatello, Idaho	1499	1182	1218	3986	3728	3867	6655
Portland, Maine	1325	1473	1321	4251	4329	3926	7218
Portland, Oregon	732	928	806	2246	2416	2530	4469
Providence, Rhode Island	1036	1177	1116	3209	3319	3246	6015
Pueblo, Colorado	1083	1010	1060	3453	3094	3224	5514
Raleigh, North Carolina	727	675	722	2132	1927	1975	3234
Rapid City, South Dakota	1141	1591	1320	3696	4372	4021	7118
Reading, Pennsylvania	958	1044	1088	3038	3039	3102	5389
Redding, California	598	540	614	1465	1594	1533	2451
Reno, Nevada	1007	950	1042	3348	3079	3326	5892
Richmond, Virginia	787	767	831	2352	2216	2211	3695
Rochester, New York	1127	1379	1252	3894	3954	3666	6732
Roseburg, Oregon	722	809	744	2297	2233	2485	4428
Roswell, New Mexico	811	709	786	2387	1902	2296	3484
Sacramento, California	562	569	614	1495	1579	1610	2653
St. Joseph, Missouri	937	1221	1187	3184	3363	3147	5161
St. Louis, Missouri	849	1022	1060	2767	2809	2798	4585
Salt Lake City, Utah	1421	1055	1110	3575	3264	3259	5555
San Antonio, Texas	456	461	381	1216	967	854	1202
San Diego, California	266	251	332	626	640	819	1645
Sandusky, Ohio	997	1197	1181	3370	3483	3323	6208
San Francisco, California	413	405	465	1173	1364	1414	3264**
Sault Ste. Marie, Michigan	1281	164	1581	4724	3609	4828	9285**
Savannah, Georgia	405	376	409	1091	921	1007	1490
Scranton, Pennsylvania	1065	1212	1172	3620	3573	3446	6129
Seattle, Washington	649	883	781	2238	2513	2650	4934**
Sheridan, Wyoming	1278	1444	1431	3911	4262	4629	8008
Shreveport, Louisiana	580	545	555	1599	1354	1324	1938
Sioux City, Iowa	1131	1567	1435	3892	4449	4018	6898
Spokane, Washington	1079	1341	1172	3572	3824	3755	6355
Springfield, Illinois	972	1159	1181	3196	3316	3183	5373
Springfield, Missouri	889	993	973	2921	2772	2647	4428
Syracuse, New York	1203	1420	1277	3997	4020	3768	6893
Tacoma, Washington	726	931	812	2527	2685	2763	5181**
Terre Haute, Indiana	924	1075	1070	3094	3130	2910	4872
Toledo, Ohio	1068	1285	1203	3723	3704	3392	6077
Topeka, Kansas	893	1145	1135	2978	3127	3018	4969
Trenton, New Jersey	970	1057	1014	3043	3004	2774	4933
Utica, New York	1267	1510	1248	4253	4238	3785	6796
Valentine, Nebraska	1200	1511	1370	3841	4289	4095	7039
Walla Walla, Washington	967	1189	989	3044	2990	2898	4808
Washington, Dist. Columbia	855	894	970	2633	2547	2711	4626
Wichita, Kansas	878	1087	1094	2789	2964	2877	4673
Williston, North Dakota	1258	2058	1805	4298	5636	5463	9323
Winnemucca, Nevada	1313	1027	1150	3575	3324	3739	6427**
Yakima, Washington	1102	1313	1159	3296	3610	3587	5599

*Includes August. **Includes July and August. (a) Data not yet available.

[1]Cumulative data identical with monthly figures for September only. In subsequent months, cumulative figures will show record for whole heating season to and including month in question.

[2]Figures in this column are normal totals for a complete heating season, September to June, incl.

Getting Personal

Robert K. Thulman

In **Robert K. Thulman** (Heating the Post-War House, page 67) we have the story of one who listened to the siren call of Washington, a call so enticing that he is still there.

Following graduation from M.I.T. in 1922 he entered the boiler business in the New York area. After three years of this he entered the government employ in Washington, D. C., expecting to remain there for three months. This brief period has expanded to nine years.

In 1937 he transferred to FHA and was concerned with the development of performance standards for heating FHA-insured properties. He served as chairman of several central housing committee sub-committees and as consumer representative on most of the commercial standard committees.

He is responsible for the development of the formula used in fuel oil rationing as engineer advisor and industry committee member to the Fuel Rationing Branch of the OPA. It requires a brave man to claim such an honor.

Mr. Thulman was also consultant to the Conservation Division and to the Plumbing and Heating Division, WPB. At present he is Chief, Mechanical Equipment Section, Technical Division, FHA.

•

A. J. Mallinckrodt

A. J. Mallinckrodt (Refrigeration Insures Quality of Clothing for the Army, page 79) is one engineer who reversed the famous advance of Horace Greely, and went east.

He received his Mechanical Engineering degree from the University of Missouri in 1922. For the period 1923-1927 he was doing estimating and sales engineering work for the York Ice Machinery Corporation, St. Louis. During the next ten years he was with the Baker Ice Machine Co., Omaha, Neb., as assistant chief engineer in charge of application and development engineering.

As the pulp writer might say, "Came the dawn." Mr. Mallinckrodt moved east and from 1937-1940 served with Carrier Corp., Syracuse, N. Y., in contract work and development engineering. From 1940 to the present, he has been associated with Edward H. Reuss, Jr., Inc., Philadelphia, Pa., distributors for the Baker Ice Machine Co. He has complete charge of all engineering and air conditioning work, including sales, engineering, purchases, and supervision of installation.

He is a member of Tau Beta Pi.

•

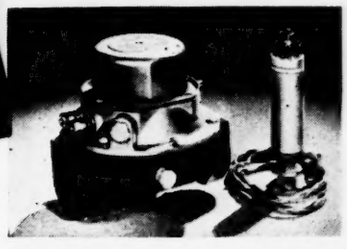
T. W. Reynolds (Evaporative Cooling, page 53) was born in the Mohawk Valley section of New York state. He has a background of 35 years experience in heating, ventilation, air conditioning and plumbing.

At one time he was manager of the Toronto, Ont., branch of Clark, MacMullen & Riley, consulting engi-

One of the outstanding features of the mobilization of industry for war production is the interchange of ideas and information among manufacturers. The pooling of vital information, unlocking the door to heretofore closely guarded "trade secrets," will help immeasurably to hasten the day of Victory. It will also contribute liberally to the improvement in construction and design of post-war products.

While concentrating on our job of turning out automatic controls for the engines of modern warfare, we are using specialized skills gained in working with new materials, new methods of fabrication. When the time comes, this knowledge will be used to help raise the already high American standards of living and production efficiency to even greater heights.

Write for Catalog 52



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neers. At other times he was with Clyde R. Place, Walter Fleisher and D. O. Kimball, consulting engineers, New York City, and Pennsylvania General Electric Co., Erie, Pa. He had his own engineering office in New York City, and for a period was a member of Reynolds & Halama, Inc., heating contractors.

T. W. Reynolds

At one time Mr. Reynolds was appraiser, New York Central Railroad.

More recently he was with Smith, Hinchman & Grylls, Inc., Detroit, on wartime plant construction for Remington Arms; with American Radiator Co., and with Walter Kidde Constructors. Now he is heating and air conditioning consultant to the construction department, WPB. He has served as secretary, New York branch, ASHVE.

Mr. Reynolds has written extensively for HEATING AND VENTILATING, and for other magazines.

•

Lester T. Avery (Penicillin, page 45) President, Avery Engineering Co., Cleveland, Ohio, is the author of the timely article on penicillin, page 45. His red letter year was 1918—not only was that the date he received his B.S. from Case, but the year he married.

L. T. Avery

He is now president of the Avery Engineering Co., Cleveland, with branch offices in Cincinnati, Dayton, Columbus and Akron. As distributors for several manufacturers, he literally feels the pulse of new activities.

Mr. Avery is active in the American Society of Heating and Ventilating Engineers. He is a member of that society's council. He also holds membership in the American Society of Refrigerating Engineers, Cleveland Engineering Society, Cleveland Chamber of Commerce, Cleveland Rotary Club, and the Case Alumni Council.

•

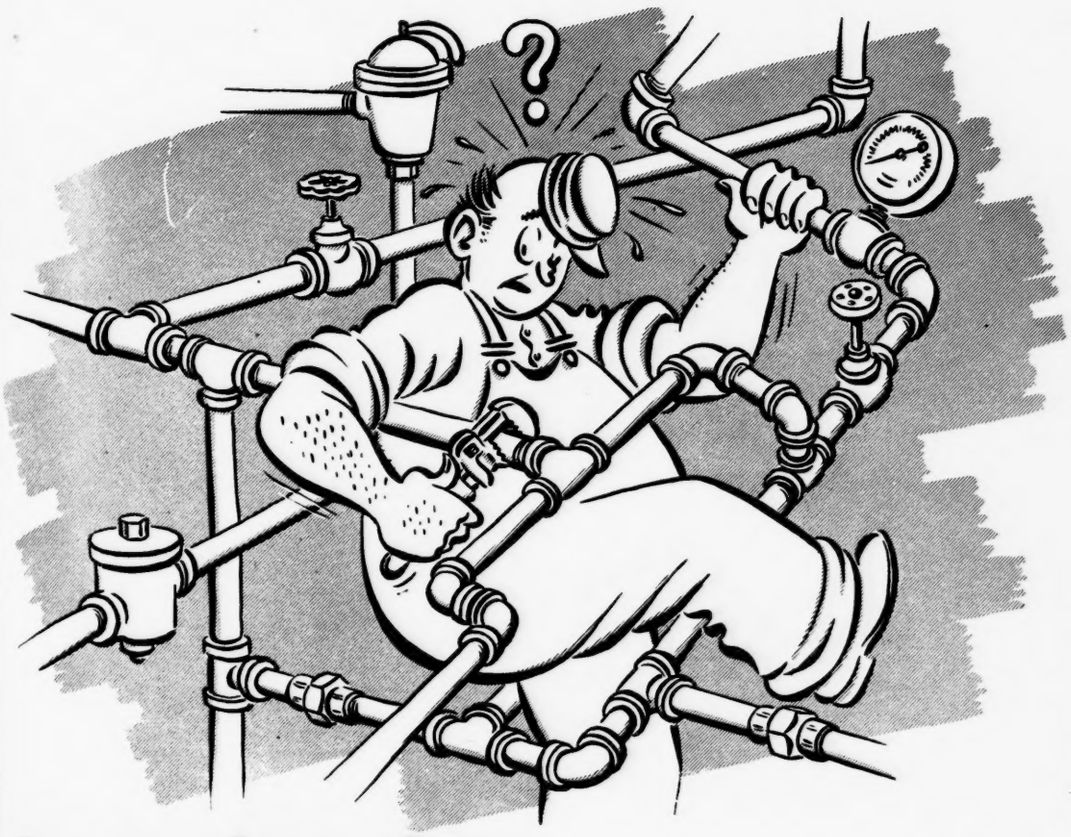
John W. Markert (Blackout at Sea, page 55) since completing his technical studies, has always been associated with some form of maritime work.

J. W. Markert

He attended Webb Institute of Naval Architecture, New York City, from 1928-31, and then studied at the Polytechnic Institute of Brooklyn where he received his B.M.E. degree in 1934. He also attended Pratt Institute, Brooklyn.

Mr. Markert served in the engine room on vessels operated by the American Export Line, Standard Transportation Co., and the United States Lines.

He was with the Federal Shipbuilding and Drydock Corp., Kearny, N. J. From 1934-38 with Gibbs & Cox, New York City; from 1938 to date with the United States Maritime Commission, Washington, D. C., as Chief, Ventilating and Heating Branch, Technical Division.



Let us share those knotty ones with you!

We don't claim to have written the book. But we *have* added a few pages to it from time to time during the many years that we have been studying out ways to make stubborn heating systems behave.

As a matter of fact, the first essential in making successful heating specialties of the type we manufacture is a complete knowledge of heat distribution systems. Just making quality valves, traps, venting devices and gauges, wouldn't mean very much if we didn't know how to apply them. By its very nature, this class of equipment functions to take the bugs out of the system. So to make a success in applying Marsh equipment we must know not only the equipment, but also the *bugs!*

That's why you will find in practically every industrial center a Marsh man whose experience can help you solve those tough ones. Now that our war production has entered a more routine stage, more of his time is released for working with you, and more of our equipment is available to solve your problems.

A few Marsh products are illustrated here — products that have proved their excellence across the years. But when you think of Marsh remember that it is more than the name of an excellent product. It is also the designation of a service . . . for *you!*

Consult your telephone directory for our local heating engineer, or drop us a card and we will put him in touch with you.

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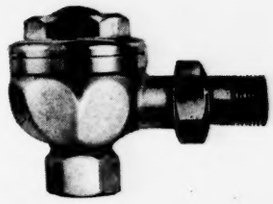
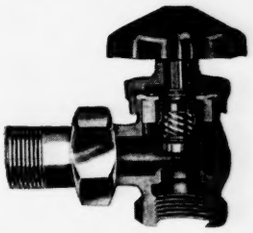
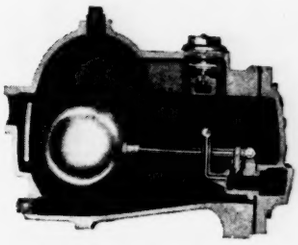


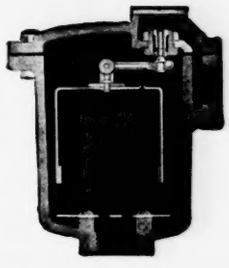
Marsh Thermostatic Diaphragm Radiator Trap. Its seamless, sensitive, powerfull bellows is the secret of its excellent performance.



Marsh Packless Radiator Valve. The unique Marsh metal-to-metal seal makes it *truly* packless.



Marsh Heavy Duty Float and Thermostatic Trap. Typical of a broad line of traps of this type.



Marsh Inverted Bucket Trap. The inverted bucket type at its best.

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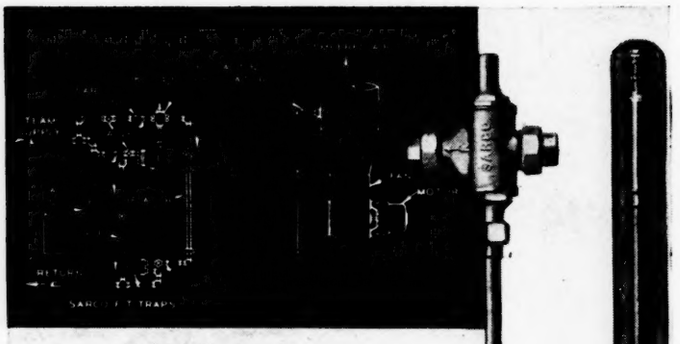

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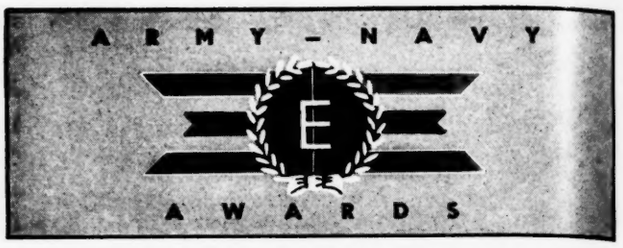

Ilg Electric Ventilating Co., Chicago, Ill. (renewal).

Air-Maze Corporation, 5200 Harvard Ave., Cleveland, O.

Worthington Pump and Machinery Corporation, Harrison, N. J. (second and third star renewals to two plants).

Blackout at Sea

(Concluded from page 62)

out louver design which allows the manufacturer leeway only as to the louver detail. All new Liberty and Victory ships have standard airports and standard porthole blackout ventilators. The blackout unit furnished with the mechanical porthole ventilators are interchangeable with those provided for the additional airports.

No one can appreciate the advantages of standardization more than those responsible for the procurement of this material. Every day brings more theories and improvements. The standard porthole blackout louver has changed the picture from "this is what I think you want to buy" to "this is what we want." It saves a great deal of time to purchase materials this way. It must not be forgotten that poor workmanship and irresponsibility cannot be tolerated with this type of equipment for *ships* and *lives* depend on it. A law is no good without the means for enforcing it, and a specification is worthless unless the material furnished is in accordance with it.

WHAT READERS SAY

Liquid-Vapor Heat Exchangers

EDITOR, HEATING AND VENTILATING:

In his section on Liquid-Vapor Heat Exchangers [HEATING AND VENTILATING, December, 1943], Mr. Parkerson has thoroughly organized the heat transfer data for such heat exchangers. The value of such a heat exchanger depends, however, in some measure upon the percentage gain in refrigerating capacity that can be obtained by its use. In this respect his method of figuring Item 13 of Table 4 on page 57, "The net gain in capacity from heat exchangers, %" is most certainly open to question.

For illustrative purposes the figures at a 40F suction temperature and 105F condensing temperature will be used here. For these conditions, Item 13 of his Table 4 shows an increase of 4.13%. This percentage increase is calculated, as shown in Item 13 under the heading "Development of Items in Table 4" (also on page 57), by subtracting the percent loss from the percent gain. It is my opinion that the percentage increase computed by subtraction is incorrect, and that the correct percentage of increase can be computed only by multiplying together Items 6 and 12 of his Table 4. Thus, from Table 4, percentage increase equals 0.878 x 1.1633 = 1.021, or 2.1% instead of 4.13% as shown by Mr. Parkerson.

That 2.1% represents the true theoretical increase

(Continued on page 102)

No matter how involved your plant layout may be, here is the most efficient solution of your heating problem:

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UNIT HEATERS STOKER-FIRED

HEAT MORE SPACE AT LESS COST

LOW INITIAL COST	— Saves money the first day
SIMPLE INSTALLATION	— No duct work, radiators or pipes needed
LITTLE MAINTENANCE	— Automatic controls do the work
WIDE HEAT SPREAD	— Heat "fans" out 200 feet
6 SIZES ALSO FOR OIL AND GAS	— 300,000 — 1,700,000 BTU

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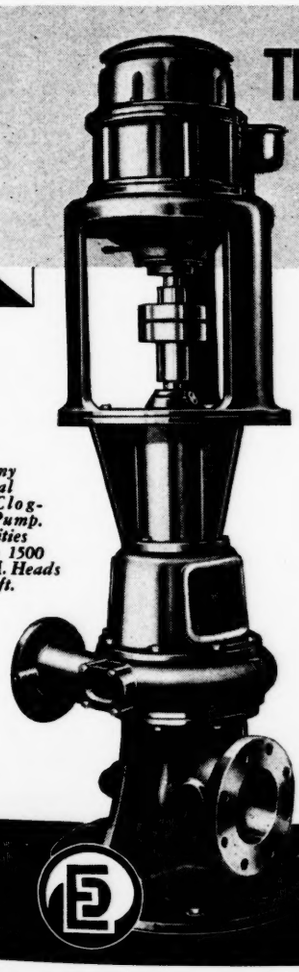
This NON-CLOGGING PUMP assures *UNINTERRUPTED* flow ...at Lower Maintenance Cost



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Helping Industry maintain continuous operations by preventing costly clogs *before they can occur,* is the special duty of Economy "Stand Up" Open Shaft Pumps. These units have generous sized clear waterways for handling unscreened sewage, miscellaneous pulps or trash without clogging. And, *uninterrupted* flow means greater gallonage per man-hour when man-power is limited. A few of the typical applications of these units are:

- Sewage Disposal
- Underpass Drainage
- Food Industries
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- Reduction Plants

Motor is mounted in a yoke directly above the pump and *flexibly coupled* to the pump. The pump has its own heavy duty bearings and separate shaft. Perfect alignment is always assured. It will pay you to write for Economy's New Pump Data Book—free to Plant Executives and Engineers requesting their copy on company letterhead.

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FIRST ON THE WATER FRONT

What Readers Say

(Continued from page 100)

rather than 4.13% as shown in Table 4 can be demonstrated in another manner. Essentially Mr. Parkerson is comparing the Btu refrigerating effect per cu ft of refrigerant vapor circulated. In his Table 4, the refrigerating effect per lb is shown to be 50.31 Btu without a heat exchanger and 58.527 Btu with a heat exchanger. From the Freon tables (ASRE Circular No. 12), the specific volume of saturated vapor at 40F is 0.792 cu ft per lb. The specific volume of superheated vapor at a temperature of 95F and at a pressure corresponding to an evaporator temperature of 40F is 0.903 cu ft per lb as obtained by interpolation from the properties of superheated Freon vapor. These figures are arranged in the table below for convenience. The "refrigerating effect per cu ft" on line 3 is found by dividing the specific volume on line 2 into the refrigerating effect per lb on line 1.

	No Exchanger	Exchanger
1. Refrigerating effect, Btu per lb...	50.31	58.527
2. Specific volume of vapor, cu ft per lb	0.792	0.903
3. Refrigerating effect per cu ft of vapor	63.5	64.8

Notice from the table above that the refrigerating effect per cu ft of refrigerant is 63.5 Btu with no exchanger and 64.8 Btu with the exchanger. Due to the installation of the exchanger, the heat that can theoretically be absorbed by each cubic foot of refrigerant circulated has theoretically been increased from 63.5 Btu per cu ft to 64.8 Btu. If the increase in capacity were 4.13% as given in Table 4, we should be able to obtain the value of 64.8 by multiplying 63.5 by 1.0413. Performing this multiplication, the answer obtained is instead 66.1 Btu—a value that is much higher than the value of 64.8 given in the above table. On the other hand, if we use the true increase of 2.1% and multiply 63.5 by 1.021, we obtain 64.8, which checks with the value obtained in the table above.

Consequently, it is apparent that the correct increase in capacity can be obtained only by multiplying together Items 6 and 12 of Table 4, not by subtracting the percentage loss from the percentage gain as was done in Table 4. For this reason it is my contention that all of the values given on line 13 of Table 4 on page 57 are too high. The true values for line 13 should be as given in the last lines of the tables below.

Condensing temperature, F		105		
Suction temperature, F		30	40	50
Item 13. Net gain in capacity for heat exchanger, %	Values as given in Table 4 ..	5.57	4.13	2.69
	Corrected values	2.8	2.1	1.3
Condensing temperature, F		115		
Suction temperature, F		30	40	50
Item 13. Net gain in capacity for heat exchanger, %	Values as given in Table 4 ..	8.09	6.34	4.54
	Corrected values	4.3	3.5	2.4

As you stated in your editorial summary, in the Trane Air Conditioning Manual I wrote that "the theoretical gain in refrigerating capacity is negligible." It is my belief that the corrected percentage values shown on the last lines of the tables above bear out this opinion.

Although the theoretical gain in refrigerating capacity is negligible, nevertheless there is some practical advantage in using liquid-vapor heat exchangers under

some conditions. For example, with small compressors it has been found that the temperature of the vapor entering the compressor has little effect upon the refrigerating capacity of the compressor. This is due to the fact that in small compressors, the heating surface of the cylinder is relatively large compared to the volume of the cylinder. As the vapor enters the cylinder, it is superheated by the cylinder walls, thus limiting the weight of vapor that can enter the cylinder. Consequently, if the vapor can be superheated usefully before entering the compressor, there will be a gain in refrigerating capacity. The vapor can be superheated usefully either by means of a coil in the air stream or by means of a liquid-vapor heat exchanger.

On the other hand, in large compressors, the ratio of the cylinder surface to the cylinder volume is smaller than in small compressors. Consequently, it has been found that for large compressors there is less superheating of the gas in the cylinder and the refrigerating capacity varies with the temperature of the vapor entering the cylinder. Hence, for large compressors it is not likely that the gain in using a liquid-vapor heat exchanger could exceed the small theoretical percentages shown on the last lines of the last tables.

LaCrosse, Wis. *William Goodman*

Clinton Hill Heating

EDITOR, HEATING AND VENTILATING:

Please refer to an article in your February 1944 issue entitled "Apartments with Central Heating Plant" by T. F. J. Moffett describing in considerable detail the novel heating system at Clinton Hill Apartments, Brooklyn, N. Y.

An article such as this will no doubt tend to influence other heating engineers, without further investigation, to specify and install this type of one-pipe down-feed system. For your information and that of other practicing engineers, this system has proven itself to date by no means entirely satisfactory.

We are all familiar with the limitations imposed upon the designers of this system by reason of government restrictions. In all fairness to them it must be admitted that the system is economical in first cost and lends itself to very efficient installation.

The basic fault with the system lies in the lack of vertical zoning, resulting in the overheating of the upper floors in an effort to satisfy the lower. The hand damper, while theoretically satisfactory, does not entirely overcome the difficulty and is obviously a makeshift. Few tenants will adjust the dampers as zoning conditions change.

Other factors, not directly related to the type of system such as, inadequate heating surface, one convector in rooms of two exposures, uninsulated floors over unheated areas in the basement, and over fresh air intakes for the boiler room, loose fitting metal casement windows and war time economy in coal consumption all contribute to unsatisfactory results.

No direct heating facilities are provided for the bathrooms, resulting in the inefficient and waseful practice by some tenants of "steaming," that is, running the hot water down the drain in an effort to warm up the room before bathing.

During colder weather, floor temperatures in a first floor bedroom will drop as low as 50F with equivalent breathing level temperatures of 60F maximum. I understand that a number of tenants employ electric heaters as a partial solution of the problem. Children playing on the floors require heavy clothing.

I do not wish to imply any criticism of Mr. Basemore, the resident engineer. In my opinion he is doing an excellent job and has done all possible to alleviate the above condition.

Brooklyn, N. Y. *A Tenant.*

▸Ask your service man to place an A-P "TRAP-DRI" System Protector ahead of each expansion valve, regardless of make. This stops all dirt, acids, solder particles and moisture that may otherwise cause valve trouble and service expense.

▸Then be sure he checks all expansion valves, replacing sluggish and inaccurate ones with A-P DEPENDABLE Thermostatic Expansion Valves. It's one way of preventing costly service shutdowns later, and assuring a smooth-operating system.

▸This is *preventative service,* costing little now, that may save you money later, and provide greater efficiency from your display cases, storage units, and other refrigeration and air conditioning systems.

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Thermostatic Expansion — Solenoid — Constant Suction Pressure — Water Regulating Valves — "Trap-Dri" System Protectors — Water Solenoids — Cooling Thermostats . . stocked and sold at refrigeration jobbers everywhere—recommended and used by leading refrigeration service engineers.

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A-P "Trap-Dri" System Protector
Stops all impurities and moisture

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